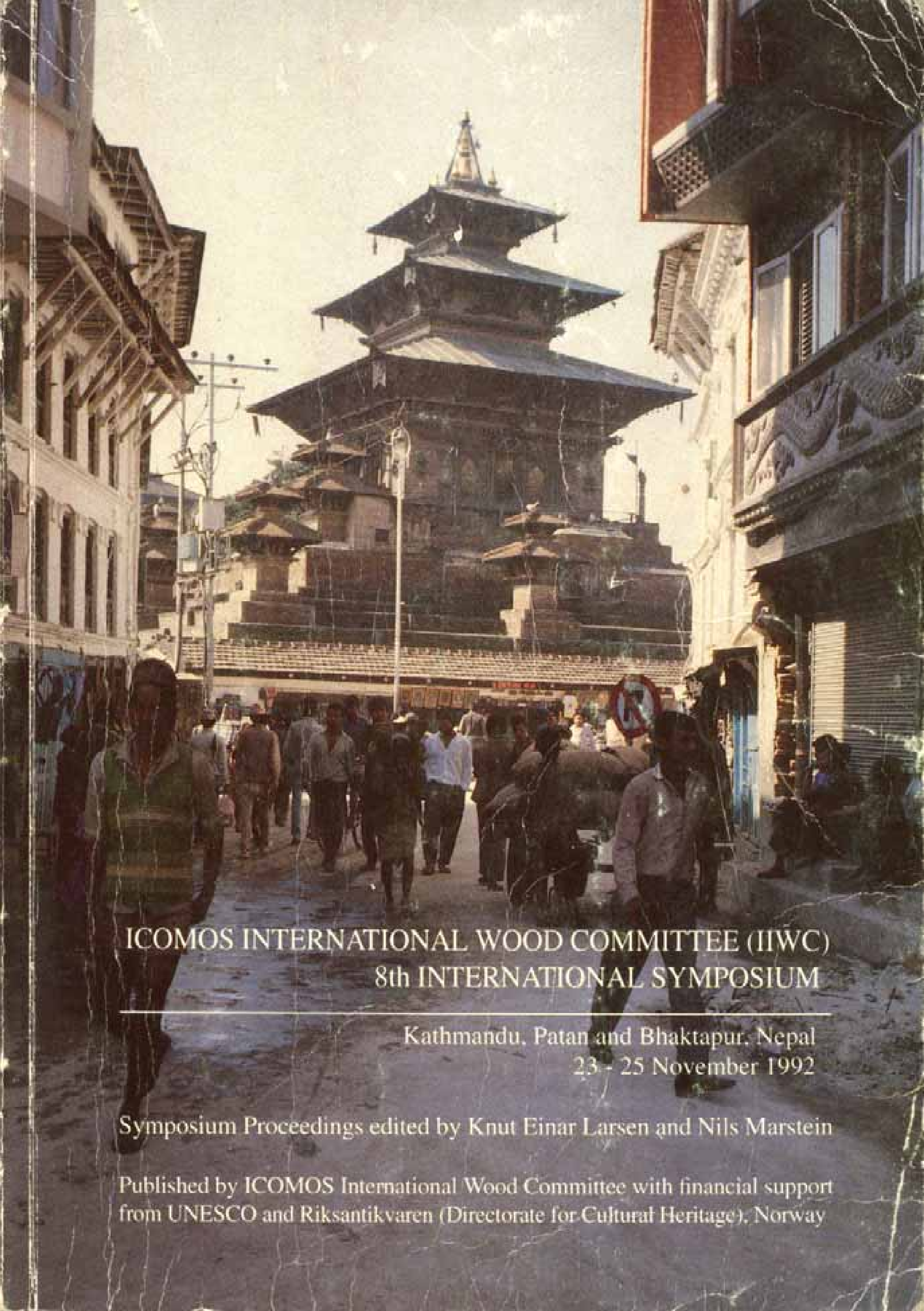

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TIMBER CONSERVATION PROBLEMS OF THE NEPALESE PAGODA TEMPLE

Erich Theophile and Rohit Ranjitkar

The following discussion of timber conservation issues of the Nepaleze pagoda temple focuses on: (1) roof repairs, failure, and rebuilding; (2) general seismic reinforcement issues and opportunities to utilize historical timber structure; and (3) the restoration of lost timber carved art in the context of Nepal's living culture. This paper is a summary of projects and research presented during the recent ICOMOS conference which visited 5 of 7 restoration projects in the Patan Darbar World Heritage Site here discussed. All projects have been developed, funds raised, and have been implemented by the Kathmandu Valley Preservation Trust in cooperation with His Majesty's Government Department of Archaeology. Erich Theophile is co-founder and Nepal Program Director of the Trust. Rohit Ranjitkar is project architect.

ROOF REPAIRS AND REBUILDING

Emergency repairs – a general preservation strategy

The majority of historical buildings in the Kathmandu Valley are brick structures with timber doors and windows and timber interior and roof frames. The dominant roofs of this architecture, best illustrated by the well-known multi-tiered roof or pagoda temples[1], are typically covered with timber planking, a mud bed, and diminuative interlocking tiles (Nepali-*jhingati*)[2].

1. Pagoda, a colonial expression which may be a bastardization of the Sanskrit *Bhagavat, Bhagavati* (holy, goddess), was used to describe the multi-roofed temples of both the Far East and the Subcontinent. (A.C. Bunnell and Henry Yule, *Hobson Jobson.* 1886). For an overview of the pagoda and other building types of Nepal see Gutschow (1987), Kom (1979), and Slusser (1982).

2. Repairs to some 300 years old and historically intact roofs at the Pujari Math, Bhaktapur in 1972 by Niels Gutschow and to the Kwalakhu Ganesh Temple, Patan by the Trust in 1992, have located extant portions of flat clay tiles above the rafters, indented with the finger as a key for the mud bed above. The use of timber – scraps, bamboo pieces, and planking as rafter cover may date only from the last two centuries or may have been an historical variant. Restoration of such tiles would in all cases necessitate a major reconfiguration of extant roof framing, spaced to carry the longer timber scraps and planking.

The principal vector in the deterioration of these buildings is water penetration through the roofs, fragile because of faulty historical detailing (discussed in detail below) and put to a difficult test each year by a three month monsoon.

Once minor roof damage has taken place, the cycle of detrioration is remarkably speedy. A small leak leads to a collapsed portion of the roof; the masonry and timber core structure, then left unprotected, is structurally endangered within several years. The decline of traditional religious and community confraternities (Nepali-*guthi*) responsible for the maintenance and ritual life of the temples, combined with the limited funds and manpower of the government authorities charged with monument care, leaves most buildings neglected at this time.

Sal wood (*Shorea Robusta*), the timber traditionally used for most decorative and structural applications, is an extremely durable hardwood related to the teak family. Given its resistance to insects in general and to fungi when protected from water, its conservation boils down to keeping the wood dry, i.e. making sure that protective roofs are sound and in good repair. Thus, the first priority of the conservation architect in Nepal will be to implement a program of small-scale and urgent roof repairs which guarantee survival of historical fabric and reduce later repair costs. One might add that given the great durability of the local sal wood and the rarity of insect infestation problems in the Kathmandu Valley[3], one should consider the allocation of funds now spent for costly imported preservative/insecticide treatments rather to such emergency roof repairs[4].

Roof rebuilding

There is a common misconception that sal was the *only* timber used in historical applications, a minor point to be clarified for the development of

3. Outside of the Kathutandu Valley other conditions prevail. Engineer Hari Ratna Ranjitkar reports that at Gorkha, the historical seat of the ruling Shah dynasty, restoration work encounteed extensive termite and beetle infestation. The Trust is currently studying and raising funds for an 18th century resthouse in Patan, the Ayuguthi Sattal, damaged by termites.

4. Application of products like Wykamol, Xylamon, and Xylophene has been popular in recent years for many local and international projects, generally applied to both new and historical timbers, pine and Sal wood alike, and then not repeated as would be necessary for any longterm effect given the estimated five year life of these products. Tests by the German Cyasilin Mandap Project further demonstrated that penetration into the dense Sal wood was no more than 1 mm. after immersion for 24 hours.

conservation approaches. In some Malla period buildings (1420–1769), local red and white pine as well as other timbers have been found employed for rafters and other interior structural framing. Frequent re-buildings in the early 19th and 20th centuries of the typically fragile roof structures, damaged by at least two major earthquakes, have also substituted these less durable softwoods. From the beginning then one must acknowledge that all contemporary roof repairs, reconstitutions, and restorations which use sal wood exclusively imply one of two assumptions: (1) that Sal wood is a restoration of the historical timber or (2) that Sal is an appropriate substitution justified by its durability.

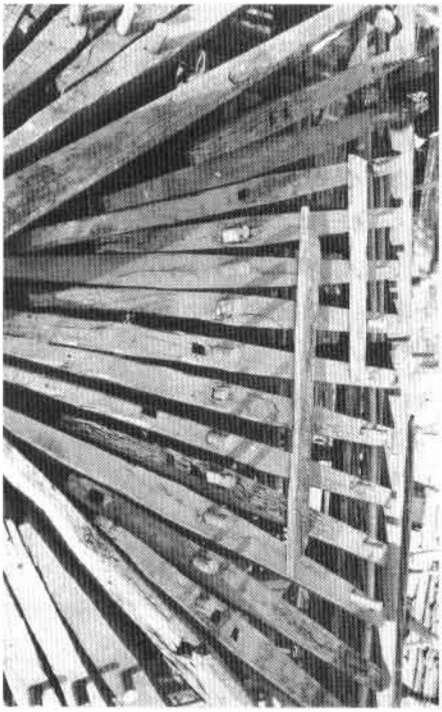
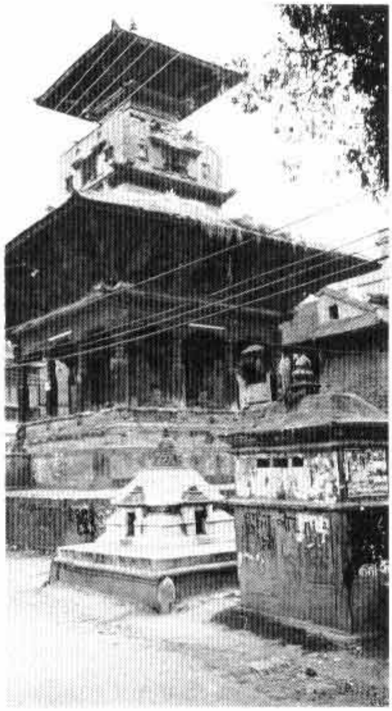
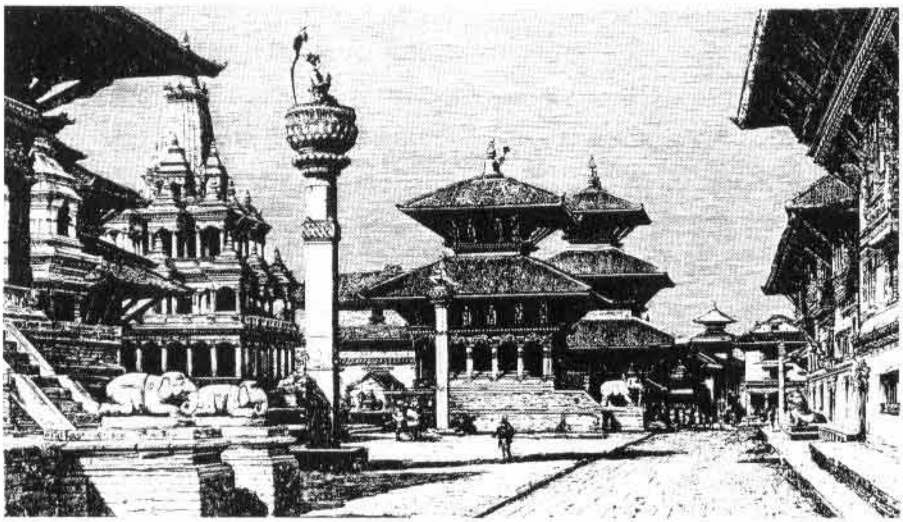
Thus, local practice to replace a *priore* all extant pine members of various ages – whether damaged or not – with Sal should be reconsidered. In these replacements the total loss of historical patina is regrettable. Moreover, as the pine timbers are generally more threatened by insect infestation when green, these historical members present no great threat to the monument's life if well protected by new roof cover.

At the Radha-Krsna (1668) and Uma Mahesvara Temples (1802) in the Patan Darbar World Heritage Site, both recently restored by the Trust, the intention was to reuse extant pine rafters (20 % of total and of varying ages), although in the end only a small number of these members were able to be conserved. In some cases severely rotted areas in isolated locations allowed cutting of lower roof rafters for reuse on the shorter upper roofs of these pagoda temples. For new timber only sal wood was used[5].

Roof failure

During the 1992 repairs and rebuilding of damaged-roofs on these two pagoda temples in Patan, documentation and analysis of all structural timbers revealed the following patterns of roof failure.

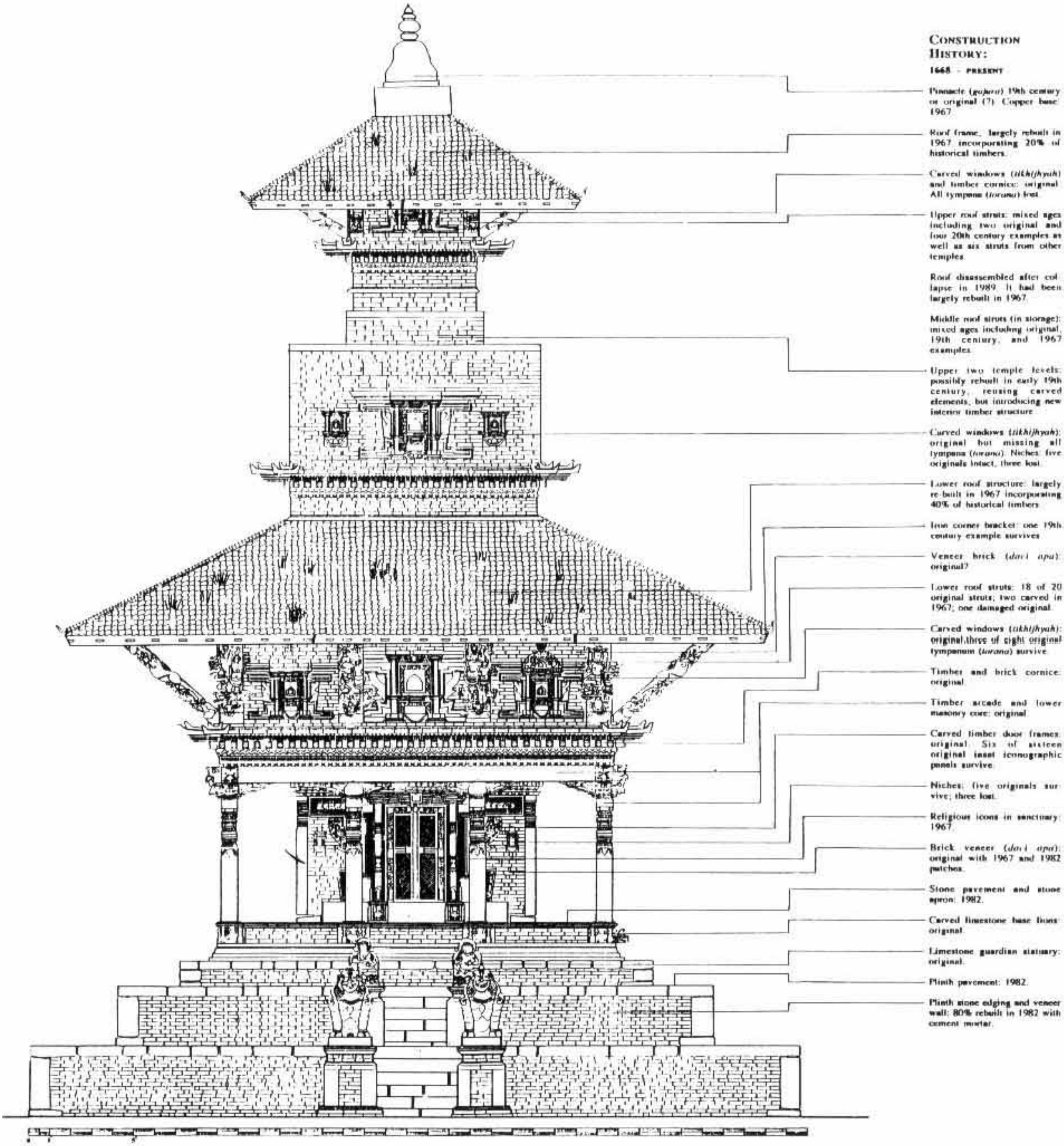
5. During the restoration of the Uma Mahesvara, funded jointly by the temple *guthi* (confraternity) and the British Ambassador's discretionary fund, the guthi threatened to withdraw support if any repaired historical timbers were re-used. The *guthi* support was critical as the project is a model for this international-local-private collaboration. A timely solution by project architect Rohit Ranjitkar saved the day. Since the timbers in question were some 20 years old and poorly finished with an electric planer, an additional shallow rendering of these timbers with the traditional adze (Nepali-*basila*) not only replaced the machined surface with an historically appropriate hand-hewn finish, but also gave the locals the impression of new wood. This shallow rendering technique was also used as a cost-saving measure for the cutting and finishing of new timbers. Machine sawing followed by this shallow rendering on three sides greatly reduced the wastage of the historical adze fabrication.

Patan Darbar Square and the Radha Krsna Temple
Below: Patan Darbar Square, view looking north, etching after an 1886 photograph by LeBon. Significant roof overhangs are features of both the pagoda emples (left) and courtyard palce buildings (right). The Radha Krsna Temple, currently under restoration, terminates the view north (upper two roofs visible). Above right: the Radha Krsna in 1992, having lost its middle roof. Above left: Upper roof framing east side (seen from above), photograph June, 1992 after *in situ* rebuilding incorporating new and old timbers, sal and pine.

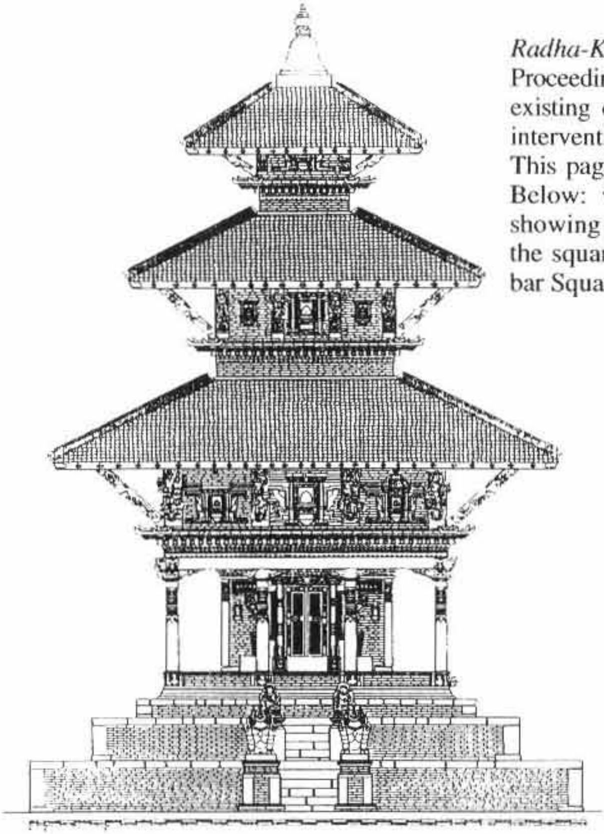
Emelgency roof repails, Patan Darbar World Heritage Site
Above: the small octagonal Mani Gufa Temple before and after emergency roof repairs, 1992. Repairs included patching of tar felt, relaying of mud bed and roof tiles, and insertion of concealed iron rods to hold the traditional stacking ridge tiles from slipping. Timely repairs prevented deterioration of the timber rafters beneath. Next page: 19th century *Pati* (resthouse) at Kwalkhu Tol. Repairs included rebuilding of the damaged roof *in situ* with the introduction of a tarfelt-bitumen waterproof membrane beneath the mud bed.



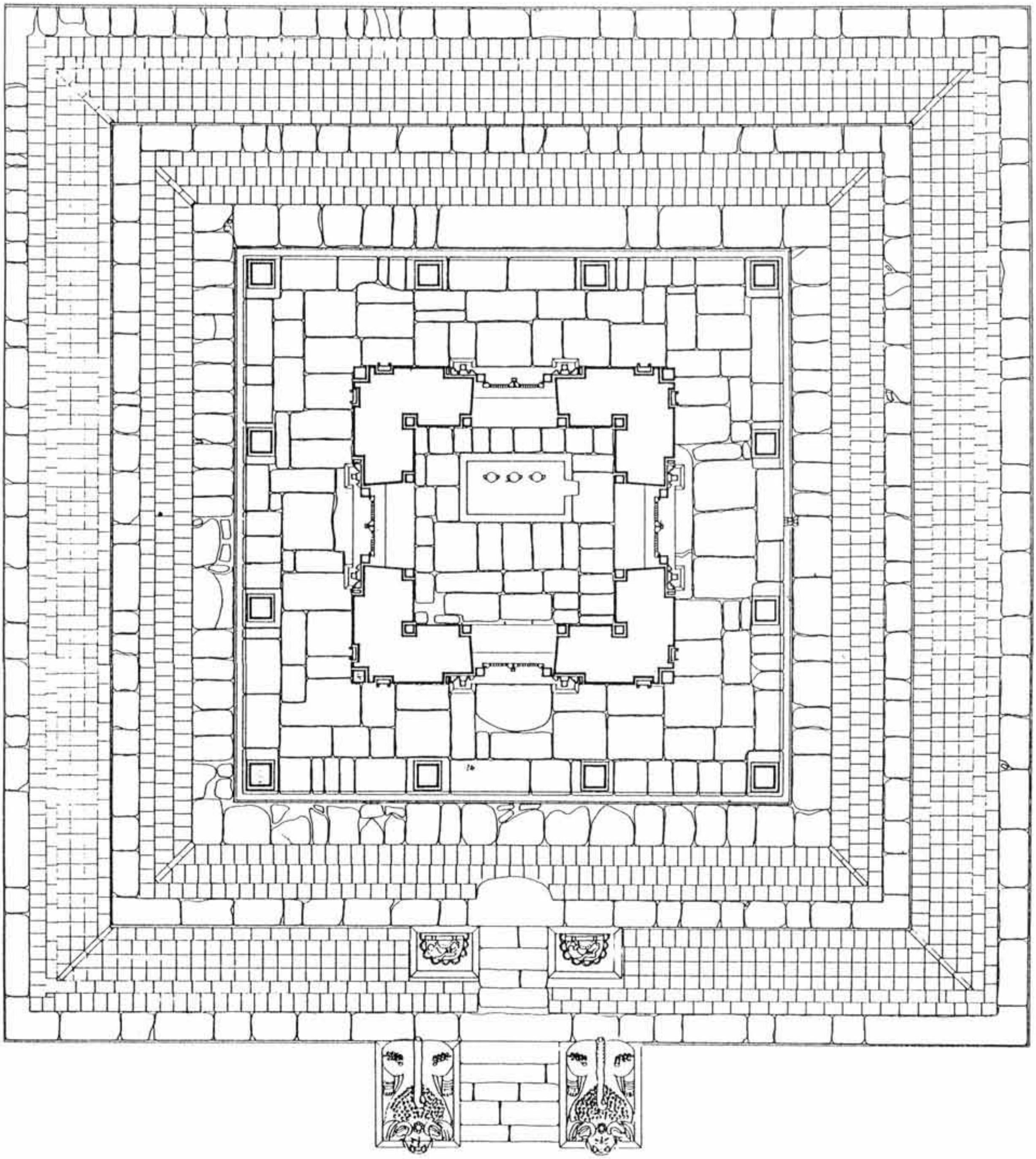
Radha Krishna Mandir

Swatha Tol, Patan
UNESCO World Heritage Site Monument Zone

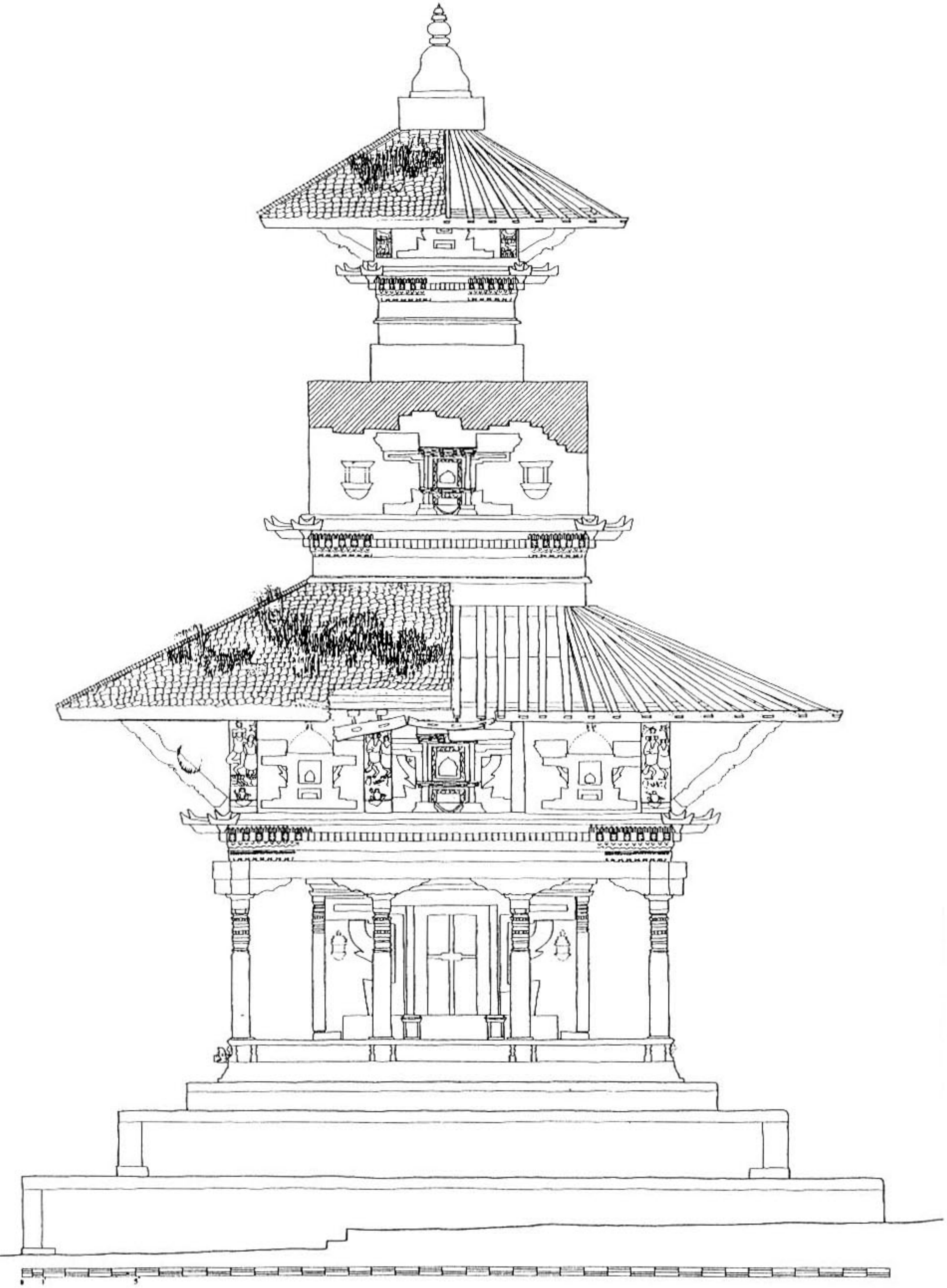
Principal Elevation: Existing Conditions
Kathmandu Valley Preservation Trust, March 1992



Radha-Krishna Temple, Svatha Tol (1668)
Proceeding page: annotated principal elevation of existing conditions identifies many repairs and interventions over the centuries.
This page, left: the restored principal elevation. Below: view of the temple in January, 1992 showing intact 19th century houses which define the square, an auxiliary space to the main Darbar Square.



Radha Krishna Temple: ground story plan, existing conditions, February, 1992. Opposite: to document the various structural and timber conservation problems (lost elements, mildew, wet rot) of the four identical facades, schematic elevations were developed for the three other sides, February, 1992.



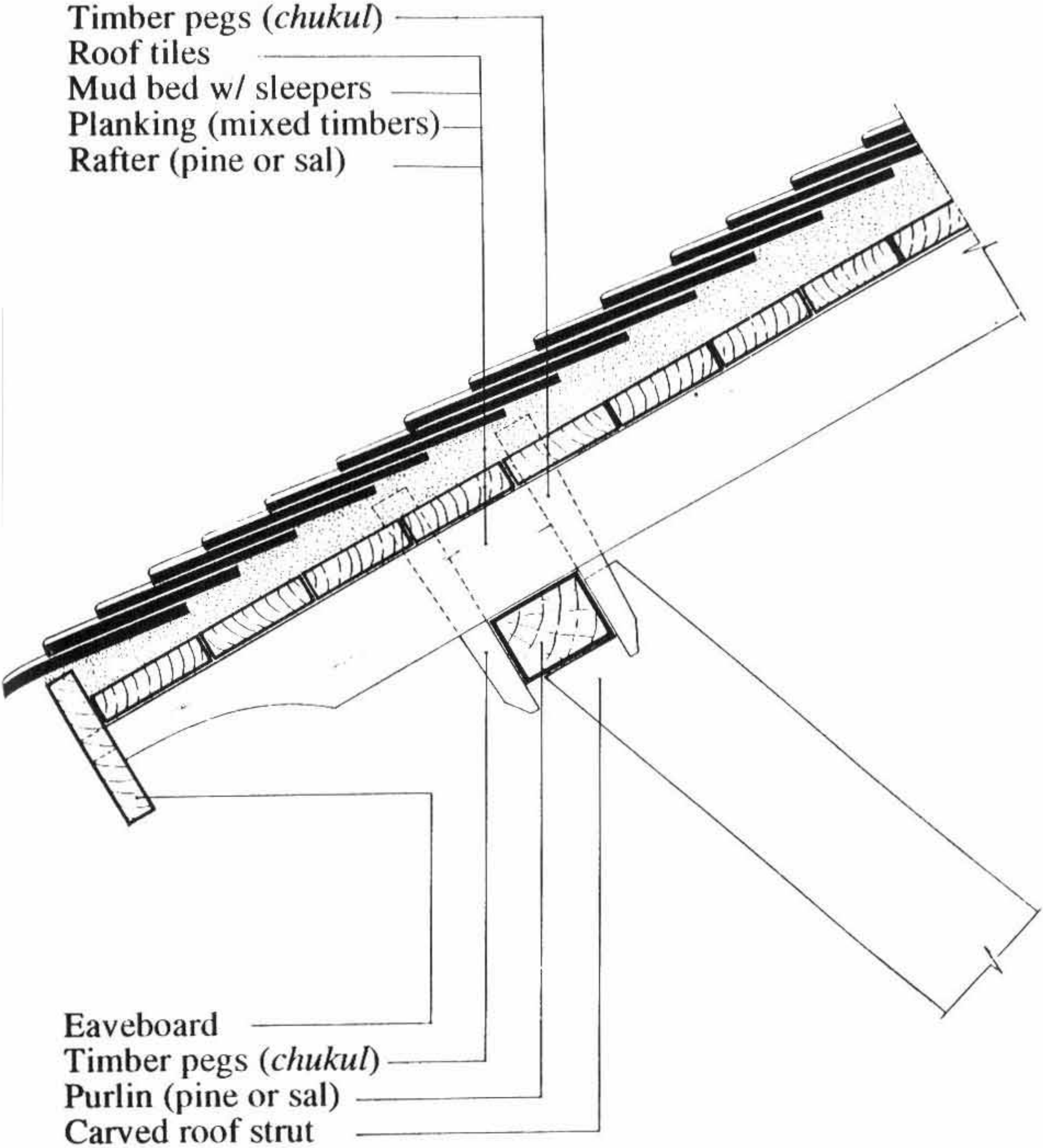
Radha Krishna Mandir

Swatha Tol, Patan

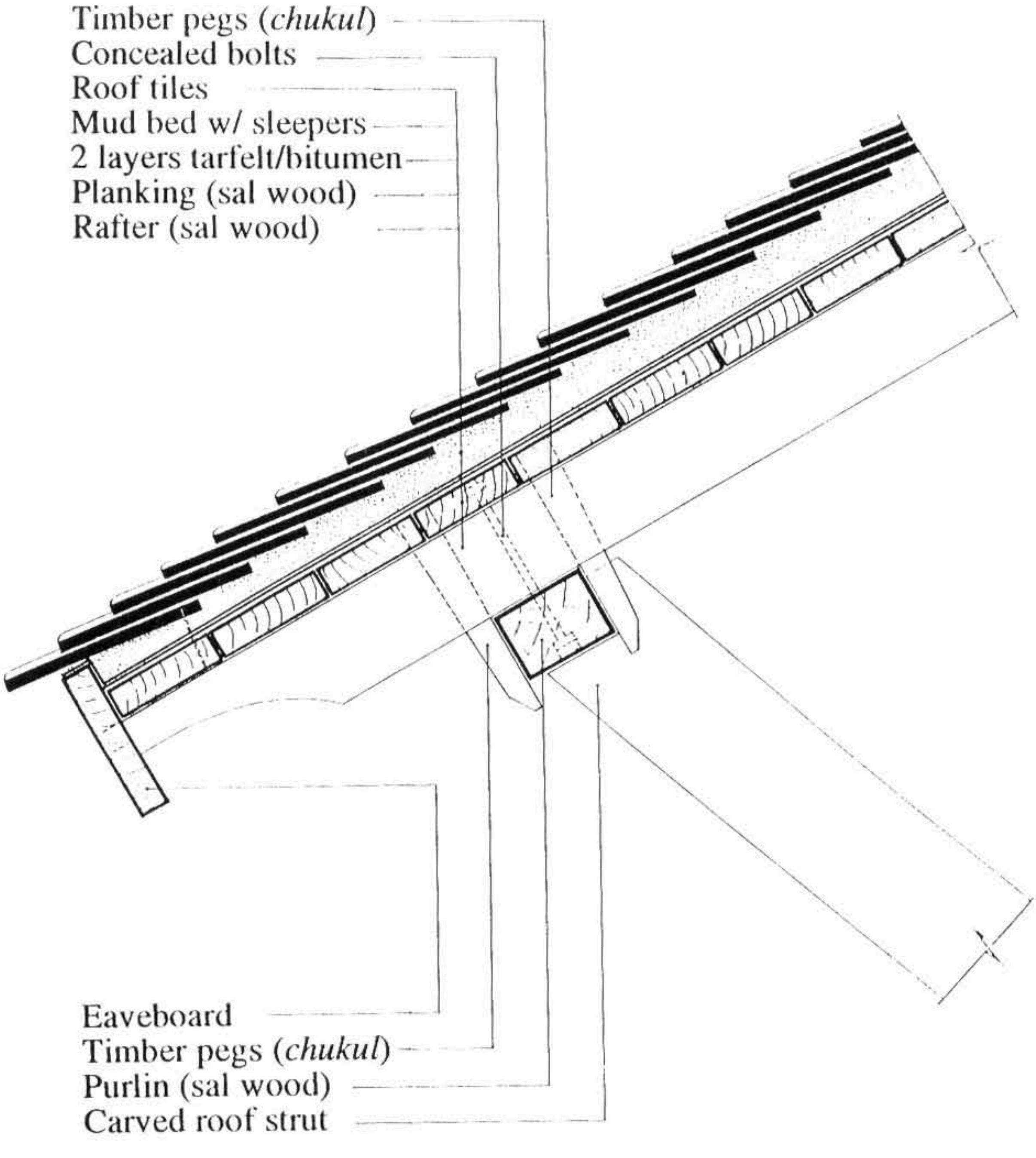
UNESCO World Heritage Site Monument Zone

West Elevation: Existing Conditions

Kathmandu Valley Preservation Trust, March 1992



Traditional *chukul* detail.
Drawing: R. Ranjitkar June 1992.



Improved *chukul* detail.
Drawing: R. Ranjitkar June 1992.

Timber pag (chukul)

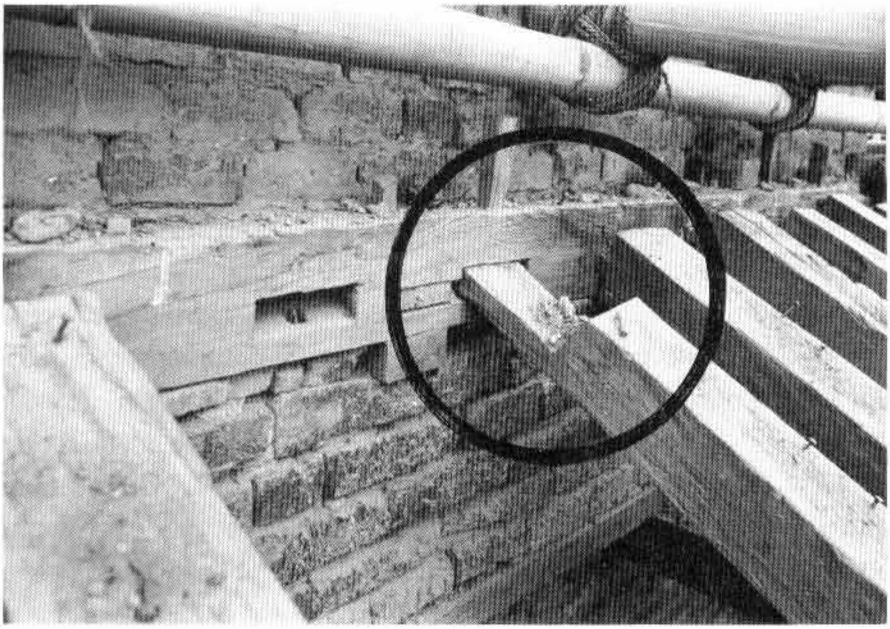
Great damage is brought on by one traditional timber joinery detail, the timber peg (Newari-*chuku*; Nepali-*chukul*) inserted through roof rafters to brace them against the wall plates and purlins on which they rest. The peg is a typical detail in many of the temple's mechanical timber connection – yet its presence in the roof is lifethreatening. Extending above through the planking and into the mud bed of the roof tiles, it provides a direct channel for moisture to penetrate to the cores of the rafters. During the monsoon when this clay bed is continuously damp, moisture naturally seeps into the *chukul* and rafter. The slight displacement of the roof tiles-by monkey, vegetal growth, or careless maintenance worker – can also create a direct moisture channel into the clay and timber. Sixty percent of *chukul* locations in the rafters of both temples, inspected after dismantling, were structurally useless, much diminishing the life of the roof. Failure around the *chukul* is characterized by enlargement of the peg hole, failure of the peg connection, and sliding off of the rafter due to the great horizontal thrust of the roof load. At the Radha Krishna Temple the roof had been rebuilt in 1967.

The purpose of this explication is not to recommend modified details to prevent this moisture penetration, for which successful solutions have been developed by both the UNESCO Hanuman Dhoka and German Bhaktapur Development Projects[6], but rather to alert professionals to the great risk of failure present in so many of the historical buildings here, even those rebuilt very recently or which may appear sound on visual inspection.

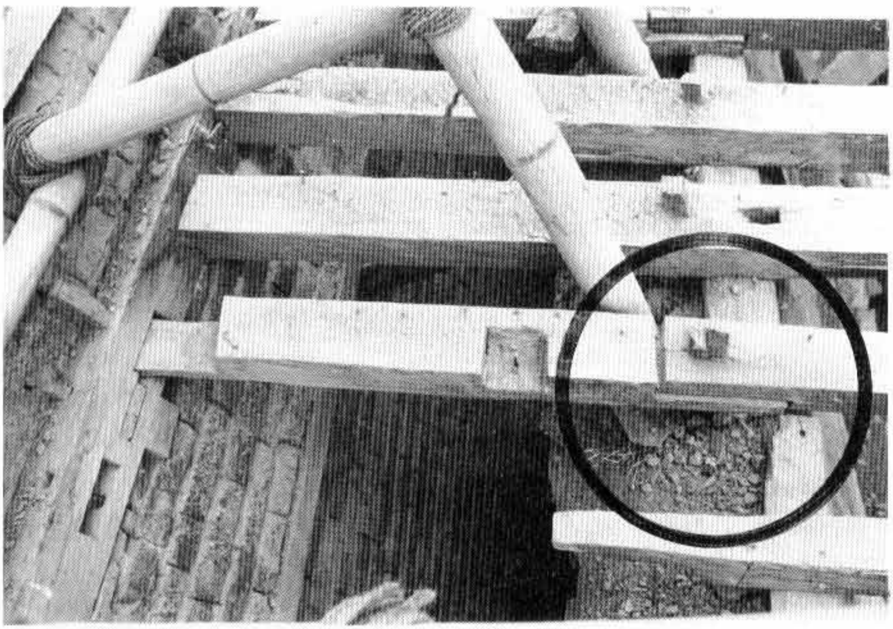
Opportunities for general structural improvement

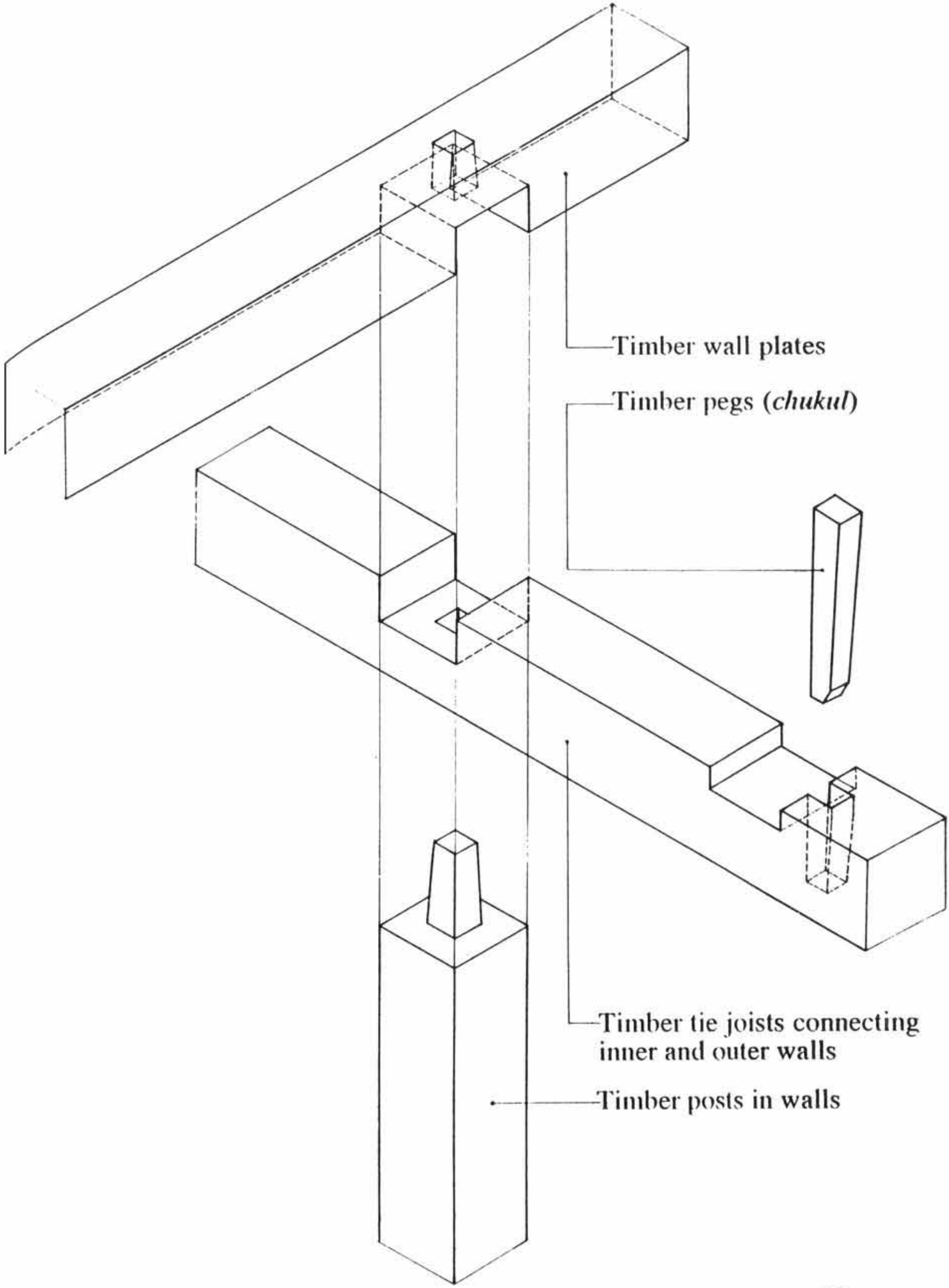
Further refinement of this *chukul* detail undertaken by the Trust has not only eliminated the *chukul* as a channel for moisture penetration, but also sought to strengthen structural connections at *chukul* locations, without elimination of the visually important *chukul* itself. The protruding *chukuls,* visible from below, enrich the texture of the roof undersides and clearly express structural connections. Given the great loads of the mud and tile roofs (300 kg/meter sq.) and local seismic activity, structural engineers working with the Trust have recommended the introduction of additional concealed bolting at this

6. Insertion of moisture barriers such as bitumen, plastic, and tar felt layers between the timber planking and the mud has proven effective over the years.



Timber Joinery from 1967 repiars at Radha Krsna Temple
Sloppy repairs and rebuilding in the last century have endangered many buildings. Above: where rafters meet upper walls of the temple, tenons have been drastically undercut, rendering the joint useless. Below: rafters (often made up of two lengths) are joined in a structurally irrational configuration: the lap joint is reversed, so that the lower length of rafter is held in place only by the small limber peg. Next page: typical traditional joinery of timber posts and inner wall plates, set into the masonry wall. Drawing: R. Ranjitkar, June 1992.




Timber wall plates
Timber pegs (*chukul*)
Timber tie joists connecting inner and outer walls
Timber posts in walls

SEISMIC CHARACTERISTICS
Radha-Krsna &Uma Mahevara Temples

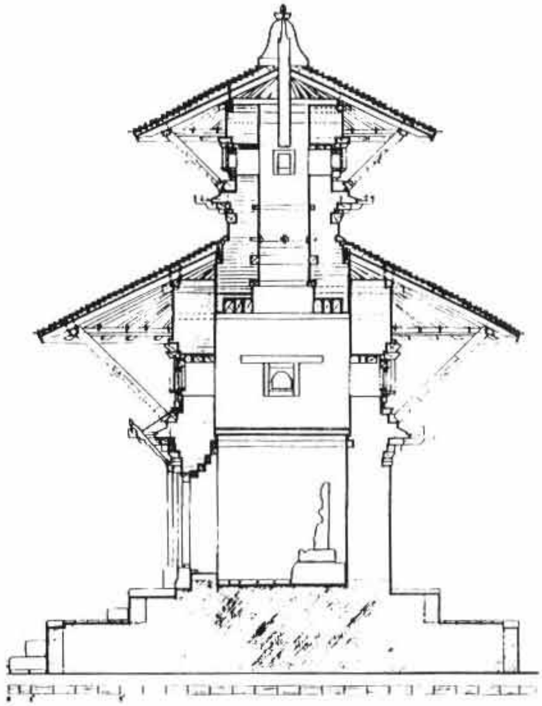
Uma Mahevara Temple (1802)

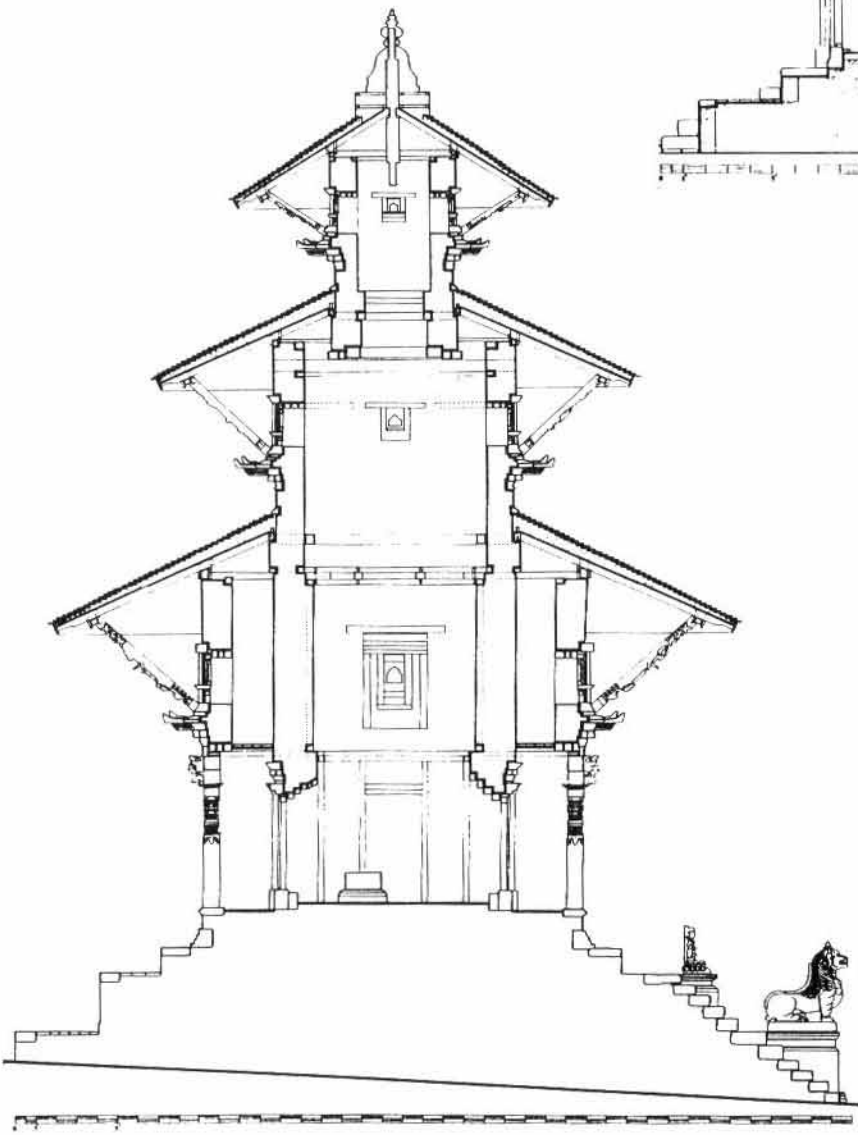
Overall proportions more compact.

Top-heavy due to great roof overhangs and heavy mud/tile cover.

Vertical discontinuity is lessened because upper walls abut lower walls. Historical timber tie structure adequate to reinforce.

Foundations?





Radha-Krsna Temple (1668)

Top-heavy due to great roof overhangs and heavy mud/tile cover.

Taller overall proportions increase risk.

Vertical discontinuity. Historical timber tie structure inadequate to reinforce.

Lack of bracing between inner and outer walls. Historical timber tie structure inadequate to reinforce.

Symmetrical placement (in plan) and small size of openings are more resistant.

Lack of bracing between two wall layers

Soft ground floor: continuous timber arcade.
Plinth: massive shock absorber?

Foundations?

location, complemented by timber notching in other roof frame locations. These improvements tie together these rather loose timber frame and masonry wall structures[7]. Working with this strategy, the project has developed a repertoire of improved wood joinery details and concealed rust-proofed bolts and angles, the latter of which are inexpensive in Nepal, even when custom fabricated.

SEISMIC REINFORCEMENT: OPPORTUNITIES IN TIMBER CONSERVATION

The pagoda temple-seismic performance characteristics

Given seismic activity in Nepal, any restoration project must consider both the reinforcement of existing structure and the introduction of new structural members to withstand earthquakes. Structural characteristics in the historical design and configuration of the Nepalese pagoda temple which affect performance in an earthquake should first be outlined.

- Lack of vertical structural continuities are created by the resting of upper temple levels on beams (to form a kind of inward cantilever) rather than directly on the wall structure below. This configuration puts the temple at risk to withstand the lateral forces of an earthquake.
- This deficiency is exacerbated by the «top-heaviness» of the structure created by the great mass of the mud and tile roof cover (300 kg/sq.meter).
- Ambulatory-like arcades at base level, a variation of the pagoda type seen at Radha Krsna, create a «soft ground floor» in seismic terms, a weak zone which may fail before it transfers the earthquake's forces from the ground to upper areas of the building.
- Lastly, overall looseness of the structure detracts from performance in an earthquake. Lack of rigid connections are found in (a) poor through-wall bonding of the multi-layer masonry wall; (b) sloppy and/or structurally deficient timber joinery; and (c) traditional timber pegged joints *(chukul)*, rigid in only one direction.

7. The Newar buildings are characterized by a sloppiness of structural joinery, whether between different layers of the multi-layer masonry bearing walls or between the various structural timber elements. The danger of «over-reinforcing» the structure so that seismic stresses would be concentrated at these new reinforced loctions seems unlikely given the overall «looseness» of the structure.

The mud mortar construction of the temple, on the other hand, improves performance in an earthquake because of its damping effect – the mud able to absorb shocks wihout fracturing adjacent bricks and/or wall areas. Further investigations might consider connections between the massive stepping plinths of some pagoda temples and greater seismic resistance. This massive plinth could act as a huge shock absorber between the earth's movement and the temple mass above. The damping quality of the plinth structure, able to absorb forces because of its mud mortar and massive construction, would also depend on the great weight of the temple structure above to resist displacement from lateral forces. This preliminary conjecture could help explain why such tall temple structures as Nyatapola in Bhaktapur or the Radha Krsna did not suffer great damages in the great earthquake of 1934.

Seismic reinforcement vs. conservation

One challenge in the restoration of such a monument is to arrive at a thoughtful compromise between full structural consolidation and the preservation of historical appearance and fabric[8]. Several opportunities offered by the typical pagoda to reinforce rather than replace historical structure for seismic performance are therefore critical starting points for the design of any restoration project. Several structural interventions developed in the Uma Mahesvara and Radha-Krsna projects are highlighted here for their ability allow reinforcement without loss of historical material.

Concealed horizontal tie members are relatively easy to insert in the gap between wall plate and rafters above the masonry walls. This technique, developed in reinforced concrete by the UNESCO project at Hanuman Dhoka in Nepal in 1976, has been popular in international conservation work here since that time. Reinforcement, replacement, or bracing of floor structures, another norm in international retrofitted reinforcements, is not invited by the vertically open core of the pagoda temple, although at Radha-Krsna a narrow perimeter passage above the ambulatory was able to be reinforced. The critical improvement to create vertical continuity in these building is very challenging and discussed separately below.

8. Discussed by R. Langenbach, 1989.

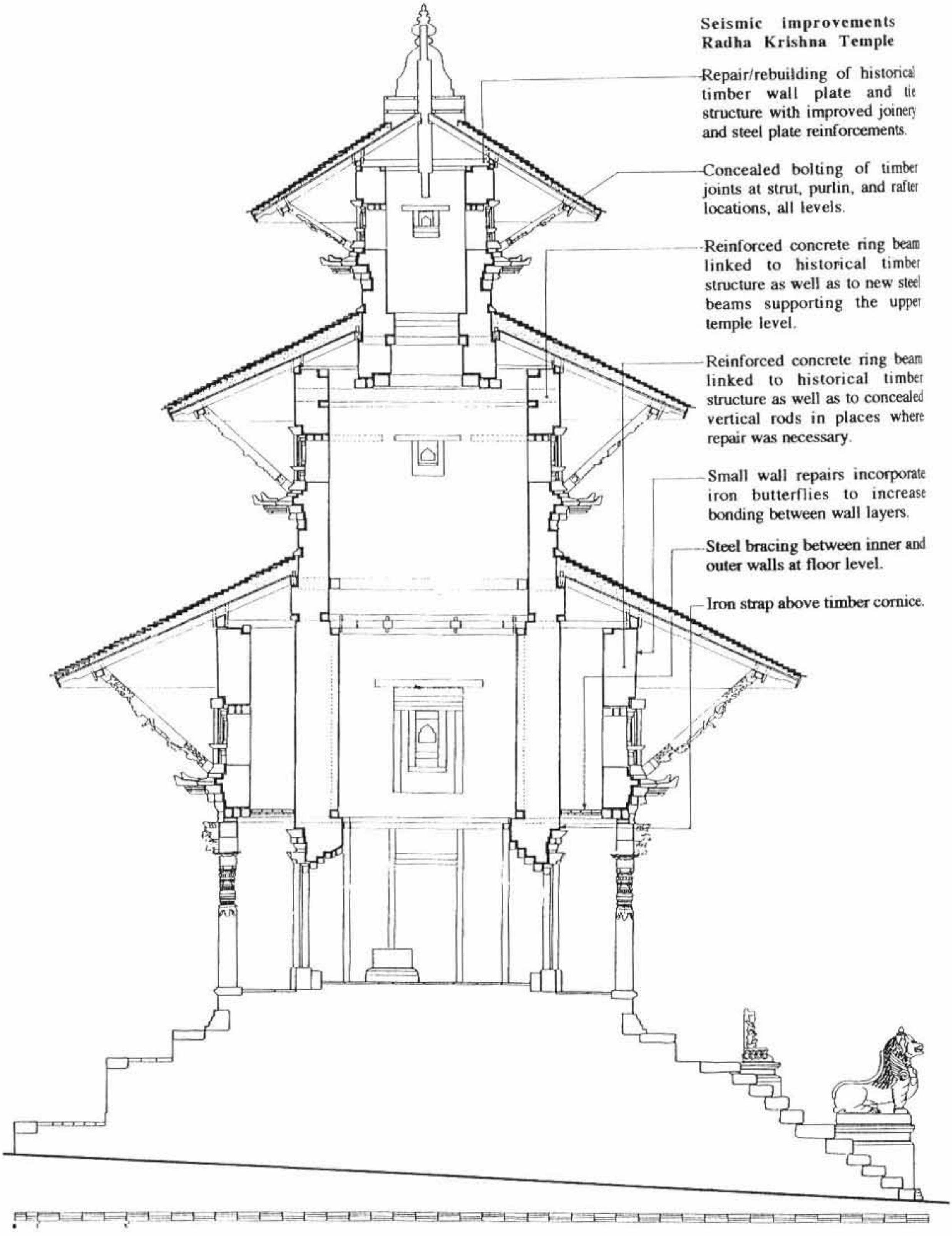
Insertion of reinforced concrete tie beams was considered for all wall plate levels of the two temples under discussion, accomplished with the rafters *in situ*.[9] The structural integrity of the historical timber tie structure at the Radha-Krsna top roof and the small size of the upper cella at this level led us early on to consider ring beam insertion necessary only at the wall plate levels beneath the two lower and larger roofs. In these locations the undersizing and poor condition of historical tie members together with the great loads of the roofs necessitated a greater intervention.

Meanwhile at the somewhat squat (and therefore less at risk) more structurally intact Uma Mahesvara pagoda, experiments with steel reinforcements at *chukul* locations helped the Trust to develop a «reinforced timber» ring beam. This solution, which incorporates existing timber tie elements with strengthening at critical locations and vertical extensions, may be considered a less invasive and, in this case, less costly alternative to the reinforced concrete ring beam. The sound extant timber wall plate and tie structures of the two Uma Mahesvara roofs invited this solution, which for larger or more deteriorated structures would be unfeasible. The timber ring beam not only allows more historical structure to be conserved, but because of its ductility and greater compatibilty with the masonry wall structure, also helps the entire structure to react together during an earthquake, the general goal of most seismic reinforcements.[10]

In addition to the timber ring beam, several other opportunities for seismic reinforcement are presented by the traditional pagoda temple construction. First, at first floor level of the Radha-Krsna, an ambulatory-like passage (the only upper floor in the structure) was identified as another location where horizontal reinforcement could easily be inserted. As this passage is used only for roof access, it was thought unobtrusive. Steel cross bracing laid on the floor in «X» patterns was installed to brace the inner and outer temple walls, providing another layer of lateral reinforcement.

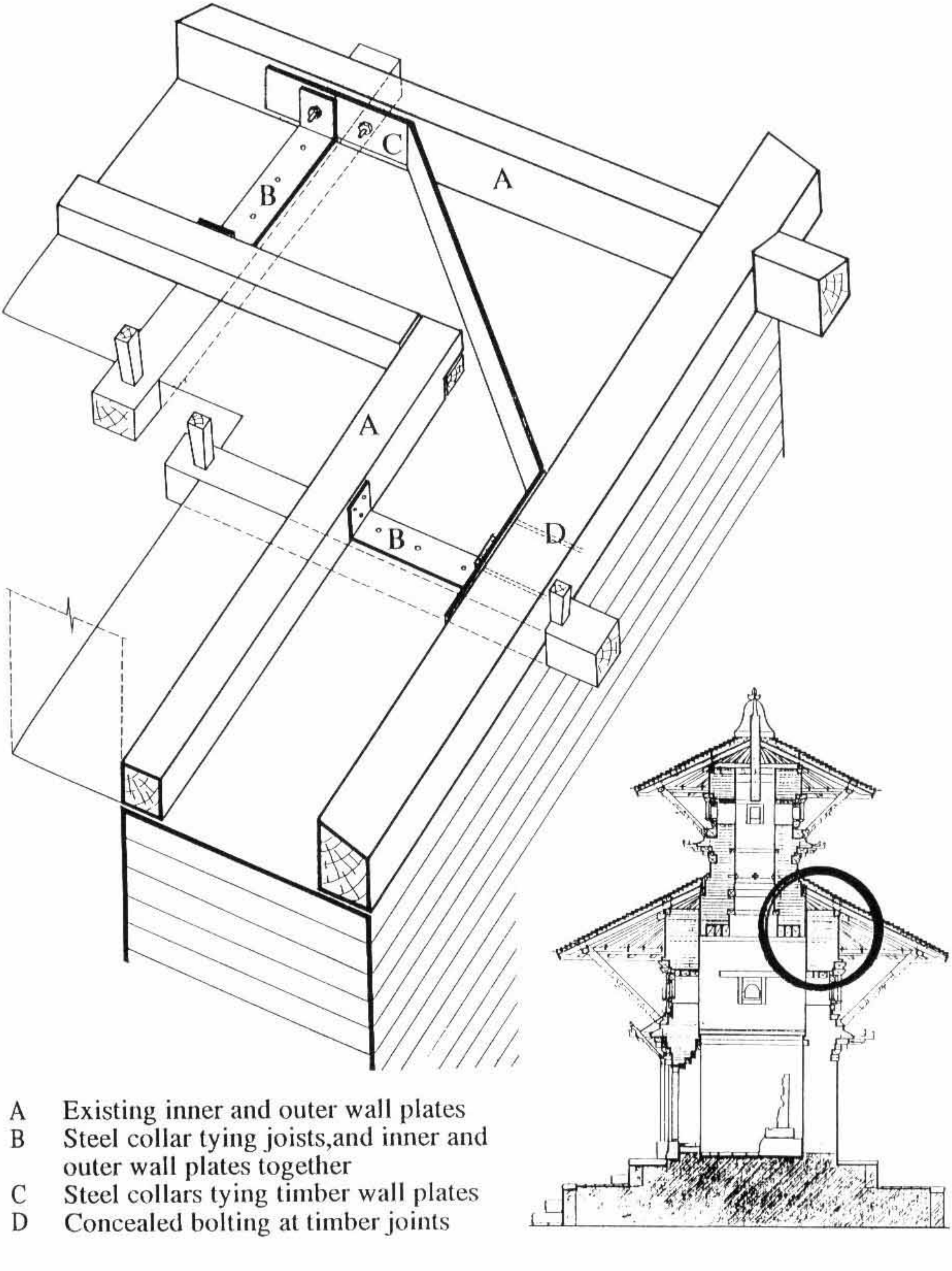
9. In most cases the rafters above can largely be left *in setu*, while reinforcing rods are slid underneath and concrete «poured» in between. This is one advantage of the reinforced concrete ring beans over the alternative steel ring beam, which is difficult to insert without more dismantling of the roof.

10. I am grateful to Sir Bernard Feilden for his thoughts on the compatibility of materials in ring beam design. His suggestions have encouraged the development of a modified reinforced concete ring beam for the Trust's upcoming restoration of the Patukva Agam (esoteric shrine house) also within the Patan Darbar World Heritage Site. Through incorporation of brick and lime into the concrete, the ring beam will be made more compatible with the wall structure.



RADHA KRISHNA MANDIR
SWATHA TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

RESTORED WEST-EAST SECTION
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1993



A Existing inner and outer wall plates
B Steel collar tying joists,and inner and outer wall plates together
C Steel collars tying timber wall plates
D Concealed bolting at timber joints

**UMA MAHESVARA TEMPLE:
STEEL-REINFORCED TIMBER RING BEAM**

Axonometric view at wall plate level below the lower roof rafters.
Drawing: R. Ranjitkar, June 1992.

Additionally, the historical timber cornices which wrap the exterior of the pagoda temples just below the roof struts are in some cases made up of quite sizeable timbers (6" x4" in section at the Radha-Krsna). Checking the joinery and condition of these timbers can ensure their ablity to act as seismic tie elements. The cornice level roughly corresponds to the height of the center of gravity of each temple level, which thus increases its effectiveness as an anti-seismic tie member. Where such historical cornices are intact but not able to act as tie members without replacement, an iron strap can be considered in the partially concealed location just above the cornice and wrapping the building. This measure is undertaken at the base level of the Radha-Krsna where the spread corner joints of the finely carved historical cornices made reinforcement of the timber itself unfeasible.[11] At upper levels the cornices are intact and structurally sound.

Vertical continuity

The most challenging problem in reinforcing the pagoda temple remains how to achieve structural continuity in the vertical direction. A major earthquake, it might be pointed out, has not hit the valley to test recent local and international experiments which have relied heavily on the lateral reinforcements of the ring beam alone, that is, without few additional interventions to achieve vertical continuity.

An «ideal» vertical linkage with the foundation, as might be achieved by drilling continuous vertical rods through the entire masonry structure, would at present be unfeasible in Nepal. Another more achievable continuous vertical frame, surfacemounted on the interior of the temple, was ruled out early on for its scarring visual characteristics. Opening up the insides of the walls to insert vertical reinforcing rods would destroy a large volume of historical building material. It should be pointed out that there is little documentary evidence about or fieldwork which has probed the foundations of the pagoda temples. Such knowledge would be prerequisite to ambitious interventions.

For the vertical continuities necessary to earthquake resistance, the typical pagoda temple structure nevertheless presents several smaller-scale

11. Again I am grateful to Sir Bernard Feilclen1 for his identification of this intervention, not originally planned for the structural improvements.

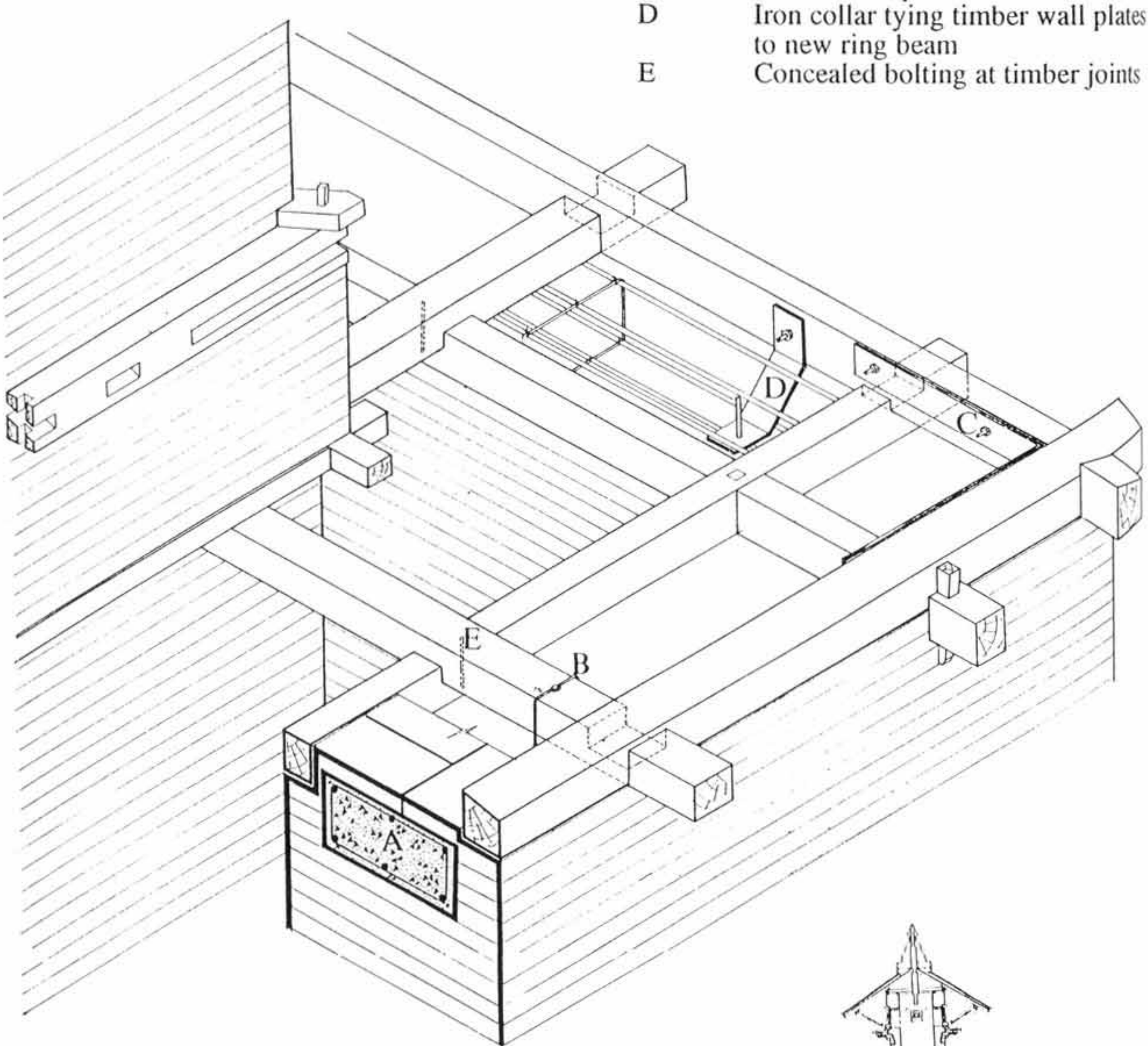
opportunities. Work on the Uma Mahesvara temple, a small temple where extant timber tie beams, wall plates, and roof structure were linked through new steel plates and improved joinery, opened the project teams' eyes to a program of interventions at the RadhaKrsna which could enhance the effect of the new reinforced concrete ring beams. Concealed bolting and steel angles could be used not only to strengthen the timber structure, but also to *extend* structural connections vertically through linkage with the new ring beams.

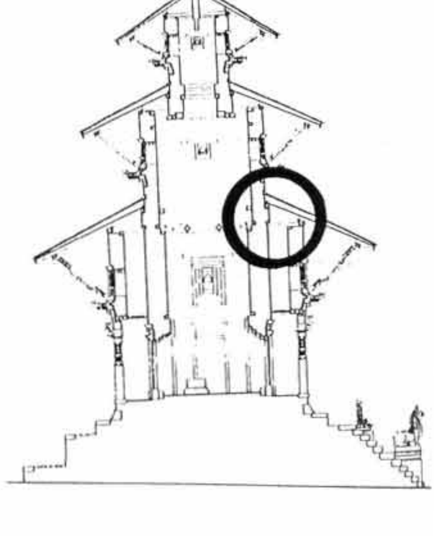
Thus, the four vertical posts of each wall of the Radha-Krsna have been linked (through improved timber joinery and steel plates) to existing horizontal timber members and both posts and horizontal tie members have been connected to the new ring beams with bolted steel plates. Additionally, reinforcements to make rigid connections at wall-strut, strut-purlin, purlin rafter, rafter-wall plate, wall platerafter, and wall plate-ring beam have been introduced. It will be recalled that most of these locations traditionally only employed the timber peg or *chukul.*

The necessity of many wall repairs just below proposed ring beams provided that the opportunity to insert into the masonry wall vertical rods up to four feet long, packed in lean cement mortar and connected to the new ring beam. Lastly, just below the uppermost level of the temple, new steel beams to support the load presently carried by damaged and undersized timber elements was similarly connected to the new ring beam above. All of the work proposed is concealed and required little destruction of historical fabric.

These small-scale measures aim to extend vertically the consolidating effect of the ring beam – be it timber as at the Uma Mahesvara Temple, or reinforced concrete as at the Radha-Krsna Temple. These improvements remain experiments, however, small-scale interventions decided on because they involved little compromise with conservation goals. Further study must further determine both the necessity of and the appropriate technologies for vertically continuous reinforcements in the pagoda structure. In sum, seismic reinforcement of historic buildings in Nepal is a field in which much

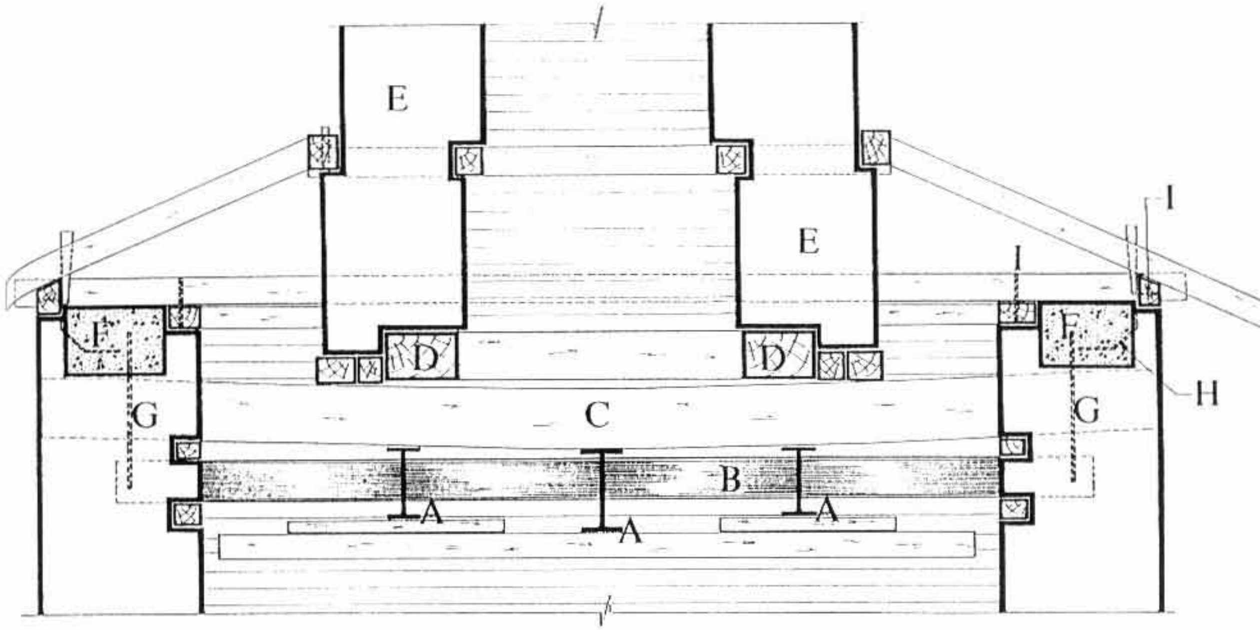
A	Continuous reinforced concrete ring beam
B	Steel connections from tie joists to new ring beam
C	Steel corner plate
D	Iron collar tying timber wall plates to new ring beam
E	Concealed bolting at timber joints

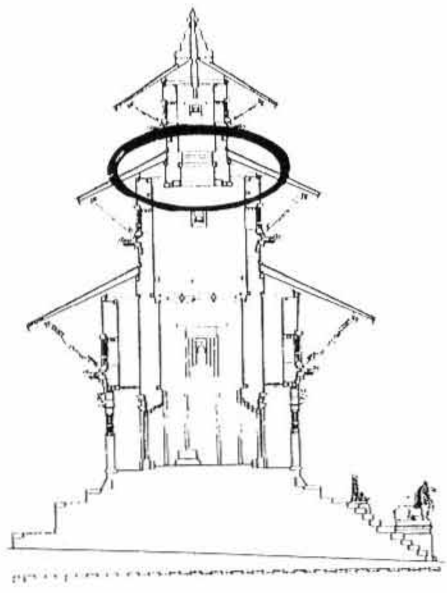




RĀDHĀ-KṚSNA TEMPLE:
CONNECTIONS TO NEW R.C.C. RING BEAM

Axonometric view at wall plate level below the lower roof rafters.
Drawing: R. Ranjitkar, June 1992.





A New steel beams to carry top level walls/roof
B New steel cross beams
C Existing principal timber beams
D Existing secondary timberbeams
E Uppermost temple level walls
F Reinforced concrete ring beam
G Steel rods connecting new steel frame and new ring beam
H Steel plates connecting timber wall plates to new ring beam
I Concealed bolting at timber joints

RĀDHĀ-KRṢNA TEMPLE:
REINFORCEMENTS BELOW UPPER TEMPLE LEVEL

Section detail at wall plate level below the middle roof rafters.
Drawing: R. Ranjitkar, June 1992.

research and experimentation must done to support ongoing preservation efforts.[12]

WOODCARVED ART OF THE PAGODA TEMPLE AND RESTORATION IN A LIVING CULTURE

Restoration of lost elements

The availability of qualified traditional craftsmen, especially for woodcarving, raises another point. Unlike more developed countries, where such replacements of lost figurative elements can be easily ruled out on the basis of unavailability, quality, or cost, here one might even be tempted to over-restore. The very special context of monument repair in a living culture – one which takes place side-by-side with ongoing votive contributions of new temples and additions to temples – forces the local conservation architect to rephrase questions of restoration philosophy[13]. In particular, when should one consider the replacement of a lost symbolic image, perhaps historically indeterminate, a thoughtful expression of the living culture and crafts found here and when to consider it in pure restoration terms, i.e. vis a vis its authenticity with respect to the historical element. Although certain general remarks can be made regarding the recreation of lost details, examples discussed below suggest that each element and project must be considered on a case by case basis.

12. Working in this direction, the German Government funded the third visit of the earthquake specialist Dr. Walther Mann of the Technische Ueniversitaet, Darmstadt to design seismic reinforcement of Bhaktapur's Palace of 55 Windows. The Kathmandu Valley Preservation Trust, in addition to consulting international experts on the subject, is supporting a team of local private-sector engineers able to implement such measures. This team, icluding architect Rohit Ranjitkar and Engineers Manohar Rajbhanadaru and Prayag Raj Joshi, participated in the German visit and site analysis. Mr. Mann's earlier visits, in connection with the reconstruction of the Cyasilin Mandap by architects Goetz Hagmueller and Niels Gutschow, included a seminar for local professionals about seismic reinforcement. Another German project, the Patan Conservation and Development Programme, has recently developed a single timber ring beam consisting of three layers to be inserted during the restoration of Vabaha Agam, a 17th century Buddhist shrine building. The design (by local engineer Prayag Joshi with architects Schrom, Gutschow, and Theophile) leaves the middle of three timber layers «free-floating» – with no structural connections to the upper or lower timber layers, designed to absorb the shock of an earthquake, while largely held in place by the weight of the roof and tower above.

13. The special case of balancing preservation of historical artifacts while allowing ongoing votive donations – with controls – at «living» monuments is treated by the recent German-funded Svayambunath Conservation Masterplan.

Woodcarved art of the pagoda

In general, the woodcarvings of the pagoda temples constitute one of the richest and most characteristic expressions of Nepalese art. Thousands of images on doors, windows, opening frames, niches, and struts contribute to a complex, sometimes inscrutable and often unique iconographical program. This iconographic program is fundamental to the conception and religiosity of the Hindu temple: the constellation of religious symbols and deities reconstructs a cosmological diagram, a *mandala*, and is integral to the architectural structure, itself holy in Hindu thought. Visually, the deep carvings punctuate the smooth facade surface of the flush-laid veneer brick (Newari-*daci apa*). The roof struts in particular contribute to an extremely rich architectural silhouette and depth, typical of these structures.

Among the Nepalese pagoda temples, one finds significant variation in the iconographic programs, even of temples dedicated to the same god or goddess. These variations may be understood as reflections of local sacred geography, mythology concerning the particular deity to be housed, the artistic inventiveness of individual carvers, wishes of the donor, or certain programmatic or stylistic conventions, which can be observed by city or period in the Kathmandu Valley.[14]

There is also a wide range in the *complexity* of iconographic programs executed in woodcarvings. A simple program not only provides fewer settings for symboliic images, but also tends to repeat identical images in comparable locations. Thus, on a less elaborate temple the replacement of a lost carving might safely copy a repetitive design, while on temples with more complex iconographic programs, the effort would be hypothetical. Such analysis, for example, led the project team to reproduce a lost niche beside the temple entrance door of the Uma Mahesvara Temple (1802), whose iconographic program is quite simple – as clearly seen in comparison with that of the nearby Radha-Krsna. The new carving, which replaces an element stolen some 12 years ago, is a mirror image of the surviving niche on the other side of the door.[15]

14. Niels Gutchow's documentation and analysis of the 1500 year evolution of the Buddhist *cartyas* of the Kathmandu Valley provides the Most comprehensive illustration of these points. Unpublished manuscript, 1992.

15. This was verified by the temple priest (Nepali-*pujari*).

ICONOGRAPHIC PROGRAM

Struts(8): 3 registers. Single main figures (Mothergoddesses) with subsidiary narrative panels. Both registers varying with repetitive floral patterns above.

4 identical corner horse struts.

Window: repetitive animal and floral figures. Central torana figures: varying(?) x 4 sides, with repetitive frames (?).

Cornice: no inset minatures

8 struts: 3 registers. Varying single deities, main register. Varying subsidiary narrative panels below. Repetitive floral designs above.

4 identical corner horse struts.

Niches: 2 deities/ elevation, repeated on 4 sides.

Windows/torana: repetitive pairs of animal figures in 2 locations x 4 sides. Central torana figures: varying(?) x 4 sides with repetitive frames (?).

Cornice: no inset miniatures.

16 struts: 3 registers, all varying. Principal figures are pairs of gods; narrative panels below, floral designs include animal, human, and deities.

4 identical corner horse struts.

12 windows with torana: different deities in 6 locations x 4 sides. Repetitive animal and guardian figures.

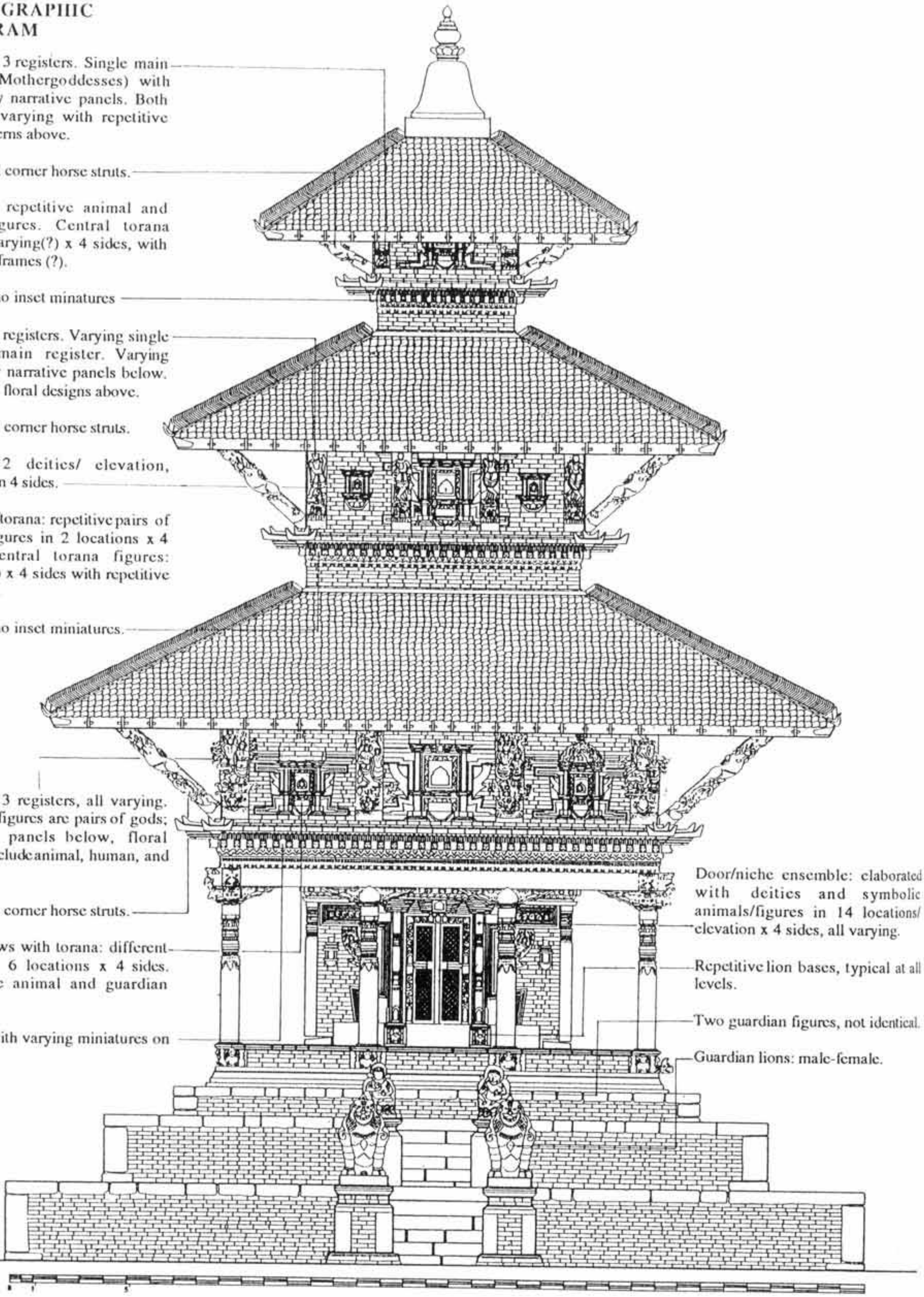
Cornice with varying miniatures on all sides.

Door/niche ensemble: elaborated with deities and symbolic animals/figures in 14 locations/ elevation x 4 sides, all varying.

Repetitive lion bases, typical at all levels.

Two guardian figures, not identical.

Guardian lions: male-female.



RADHA KRISHNA MANDIR

SWATHA TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

RESTORED PRINCIPAL ELEVATION
KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993

ICONOGRAPHIC PROGRAM

8 struts: 3 registers. Single main figures (Mothergoddesses) and subsidiary narrative panels, both varying, with repetitive floral patterns above.

4 identical corner horse struts.

Window: repetitive floral and animal figures.

Cornice: no miniatures.

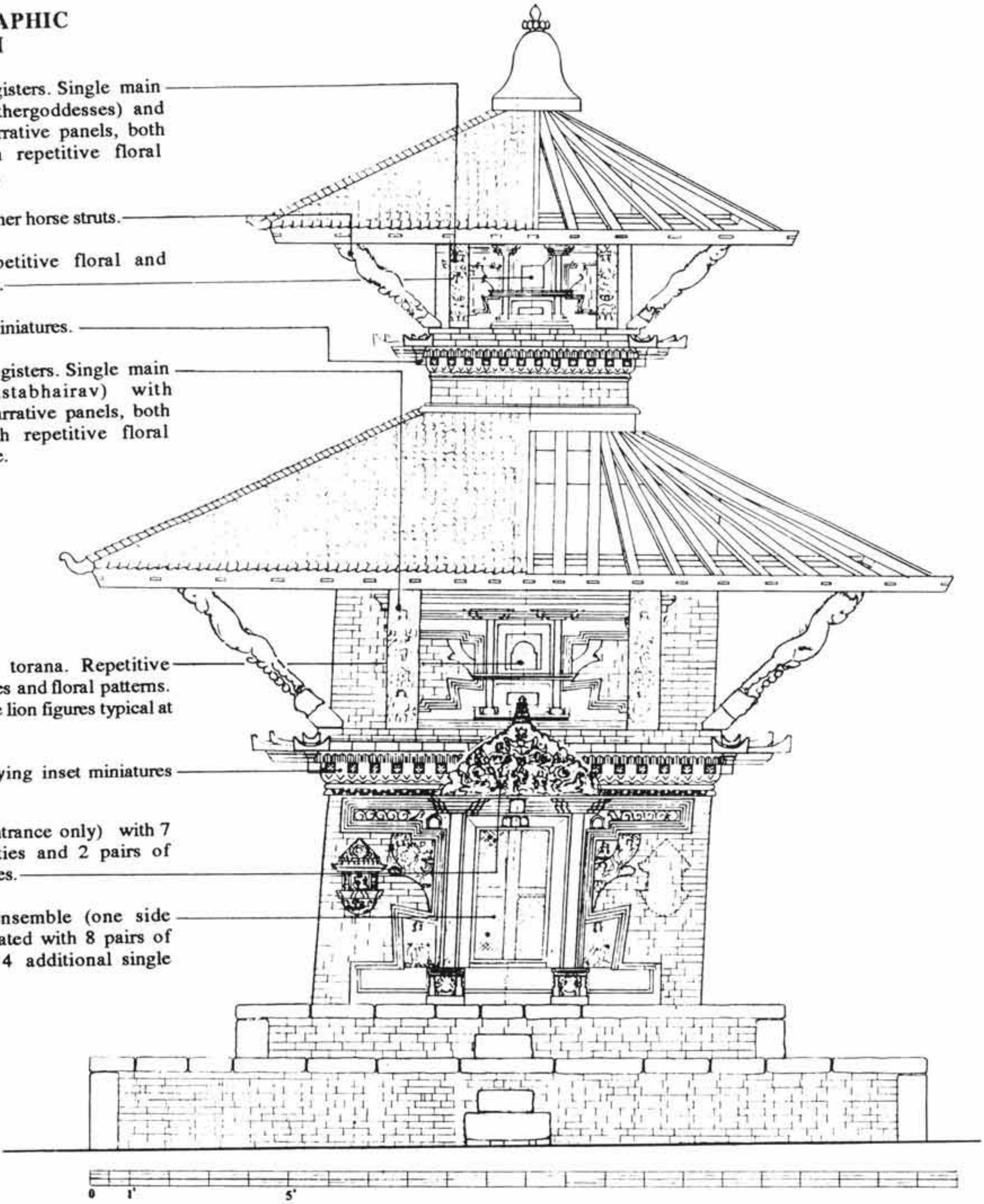
8 struts. 3 registers. Single main figures (Astabhairav) with sudsidiary narrative panels, both varying, with repetitive floral patterns above.

Window: no torana. Repetitive animal figures and floral patterns. Repeated base lion figures typical at all openings.

Cornice: varying inset miniatures on all sides.

Torana (at entrance only) with 7 different deities and 2 pairs of guardian figures.

Door/niche ensemble (one side only): elaborated with 8 pairs of deities and 4 additional single deities.



UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

PRINCIPAL EAST ELEVATION: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992

On more elaborately carved pagoda temples, especially typical of those built under the royal patronage of the Malla era (1420–1769), virtually no two figures or decorative details are identical. What appear to be identical columns in the continuous arcade of the Radha Krsna Temple, for example, are upon close inspection varying in minor decorative elaborations. At the same time, an historical trend in the last centuries has replaced many lost elements with copies of symbolic figures from other locations on the temple – even when the copied figure seems to be inappropriate to the historical arrangement or recognisable iconographic program. This practice has been so pervasive for so many years it has become an historical feature of a large number of temples.[16]

This trend is well illustrated on the Radha-Krsna Temple: at least four generations of carved roof struts are discernable, ranging in age from the original mid-17th century elements to those of renovations in the early 19th century and in 1967. Several struts from other temples – different in format, yet related thematically – are also found. Although it is clear that the original program of struts was nonrepeating, the majority of nineteenth century and 1967 elements are copies of earlier struts on other sides of the temple. The 19th century examples even reproduce keys to cardinal orientation (encoded in the subsidiary panels) and installation notches at the strut base, both of which make no sense in the copys' existing locations[17]. The crude carving, simplification, and contrasting number of figures of one 1967 strut on the lower and most visible level even tempted consideration of removal. Yet, given priorities to *preserve* rather then restore and lack of documentary evidence of lost struts, it was deemed appropriate to maintain this most recent historical layer.

In one location where no strut survived, the project decided to reproduce an historical example based on the advice of a local expert in iconography. The new strut includes a visible inscription with date. Two considerations influenced this decision. First, the presence of so many struts of different

16. (Gail's (1984) analysis of original and replaced icons in the auxiliary niches of the 16th century Char Narayan Temple in Patan Durbar Square, for example, identifies the historical correspondence between certain deities and their cardinal orientation on the temple structure. Thus, replacement elements, which literally copied a western god, so to say, to fill a northern niche, were clearly recognisable.

17. The subsidiary panels of all middle roof struts depict a priest worshipping a *sivalinga*, whose spout must always be oriented to the north. Thus, struts on the east elevation of the temple show the spout pointing right or north; those on the north elevation are shown head-on.

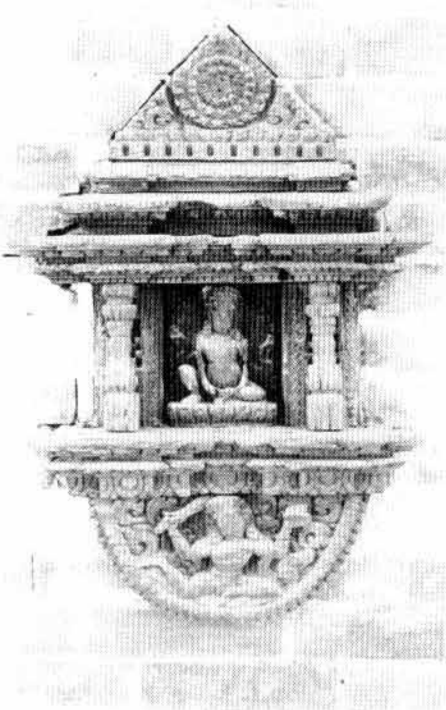
quality and age on the temple make the building a living and diverse record of artistic and religious development – there was *no* hope to restore the configuration of struts back to any specific date. Even if one removed later struts, for example, the original placement of many historical struts was unverifiable. This new strut is thus seen as a continuing in this longstanding tradition of adding contemporary struts in traditional style.

Secondly, given the otherwise intact[18], albeit unoriginal, constellation of carved struts, a single plain strut would have interrupted and distracted visually from this focal zone of decorative work. Designing a new variation in reduced form, visually consistent with the carved elements, but clearly recognizable from the historical, would have required intensive design and experiments, time perhaps poorly spent when the traditional craft is alive. This living craft, of course also worthy of preservation and support, is able to produce results consistent in artistry with historical examples, that is, when well paid and supervised.

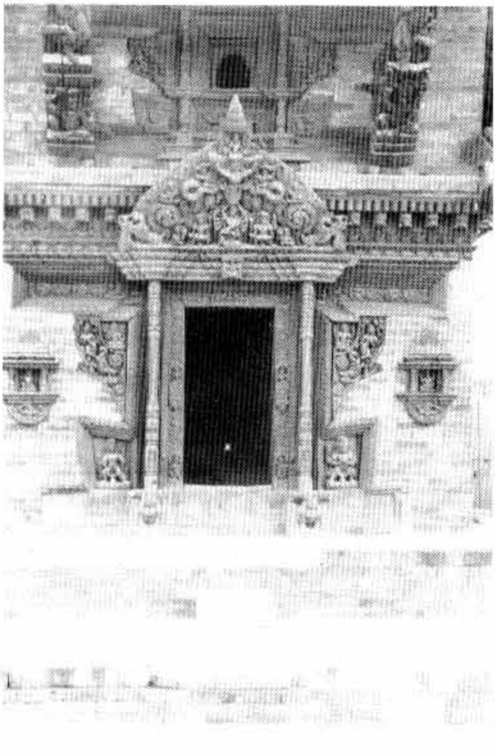
Another problem was posed by missing woodcarved panels depicting various deities in many locations on the Radha-Krsna Temple. Lost elements include: 25 of the 28 historical tympanum (Newari-*torana*) above upper level windows; 10 of 16 decorative panels fitted into the extended frames of door frames; 6 of 16 small niches on base and middle levels. The loss of these elements can be attributed to theft at ground level and to improper historical fastening at upper levels. In many cases, the deity appropriate to each location could be determined through iconographic analysis, although symbolic mounts, weapons, hand positions (Nepali-*mudra*), and decorative details of the originals were indeterminable.

Restoration of both the visual effect of the hisorical facade and of the main features of the iconographic program would encourage the replacement of identifiable figures in a traditional style with a small inscribed date to make clear their provenance. The communities who continue to use these temples, whose support *must* be sought to expand local preservation efforts, would of course always demand a restoration of religious figures which can *be seen and worshipped*. In contradistinction, a strict interpretation of article 9 of the Charter of Venice to «stop at the point where conjecture begins» would leave these carved locations empty.

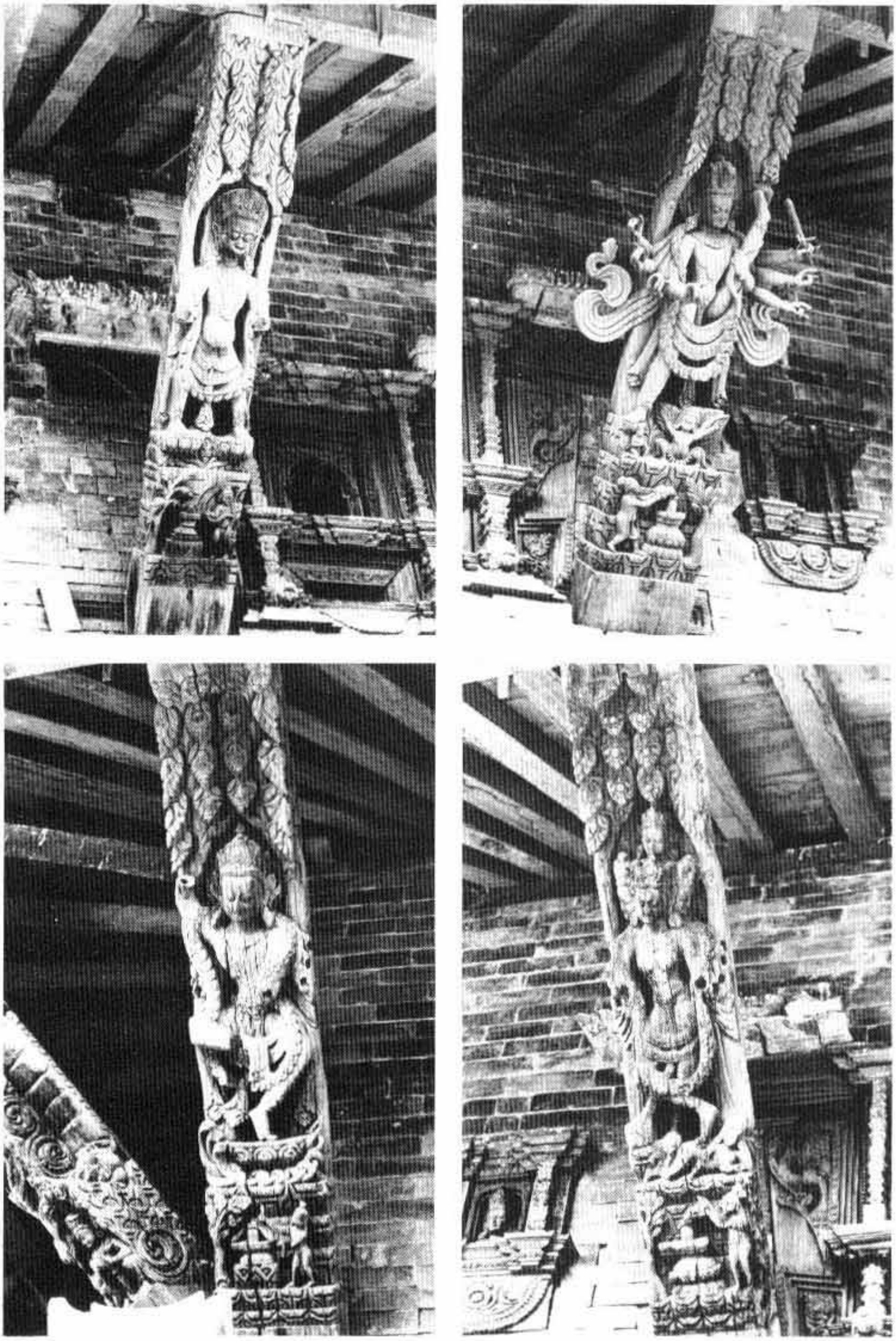
18. Fragments of another lost strut, recovered from the interior of the building during cleaning, were reconfigured and installed on a new steel frame. Lacunae were not reconstituted.



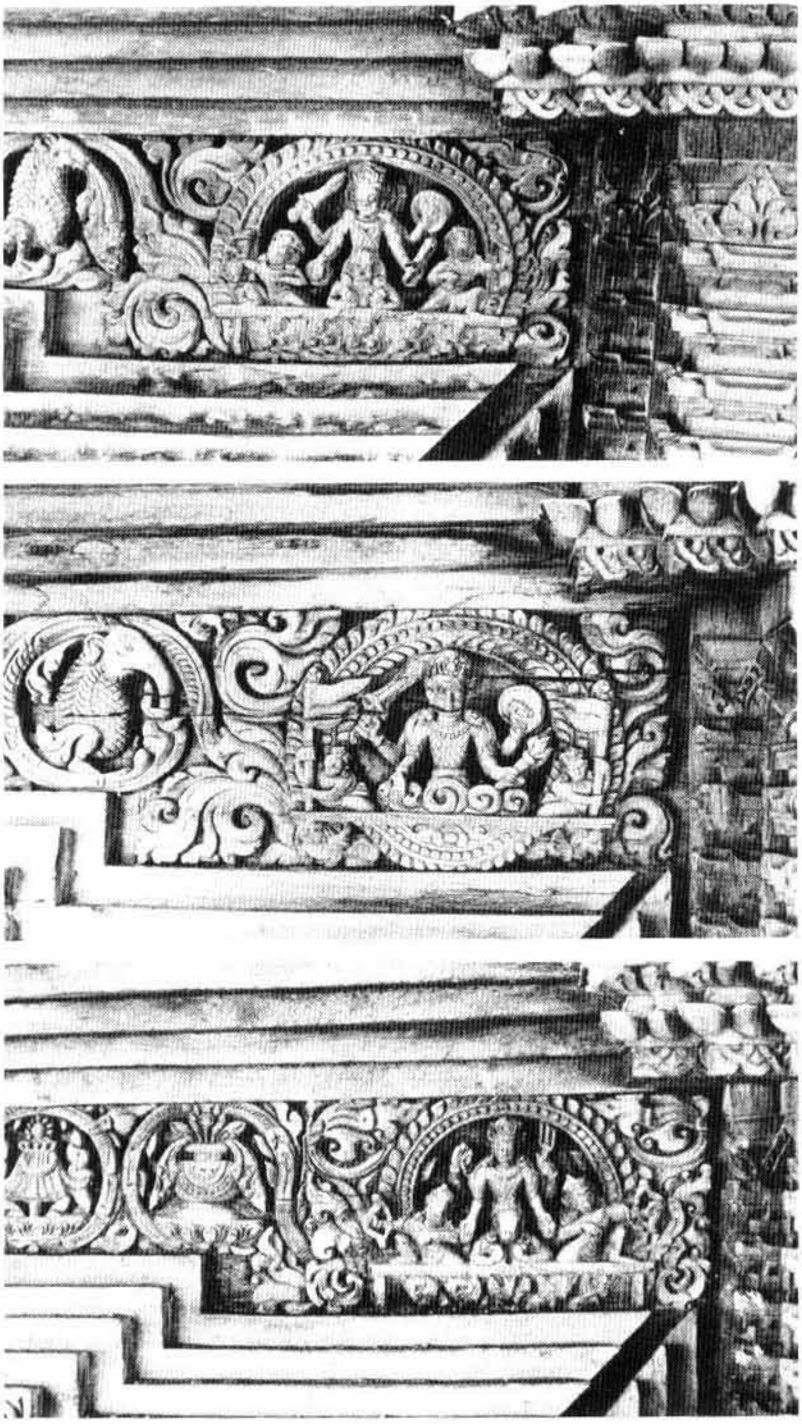
Uma Maheseara Temple:
Replacement of lost niche
The pair to the original 1802 niche left of the door was stolen some 12 years ago. The repetitive imagery of the niche (as reported by the temple priest) allowed a new niche to be carved.



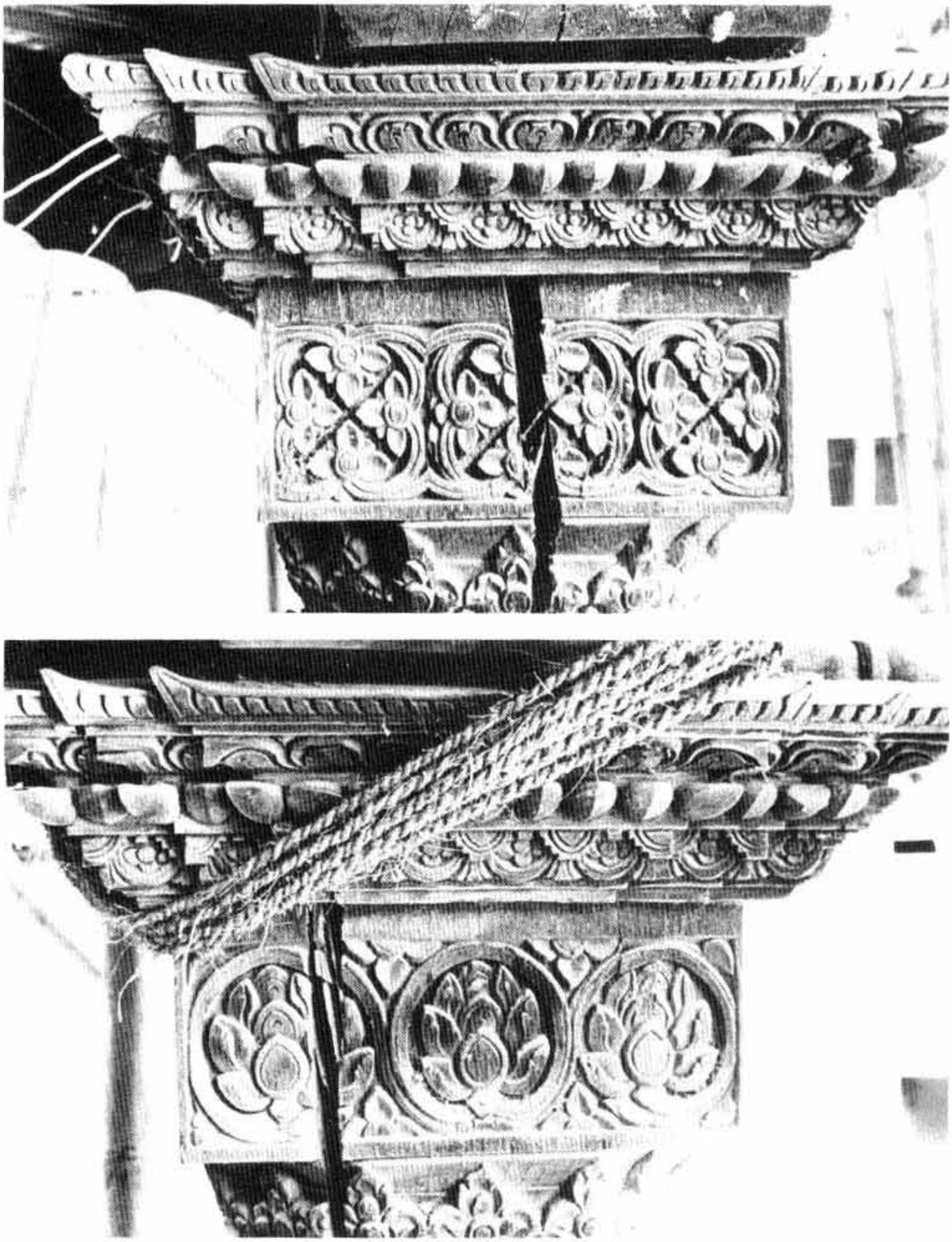
The facade with new niche in place (-right of door), August, 1992.



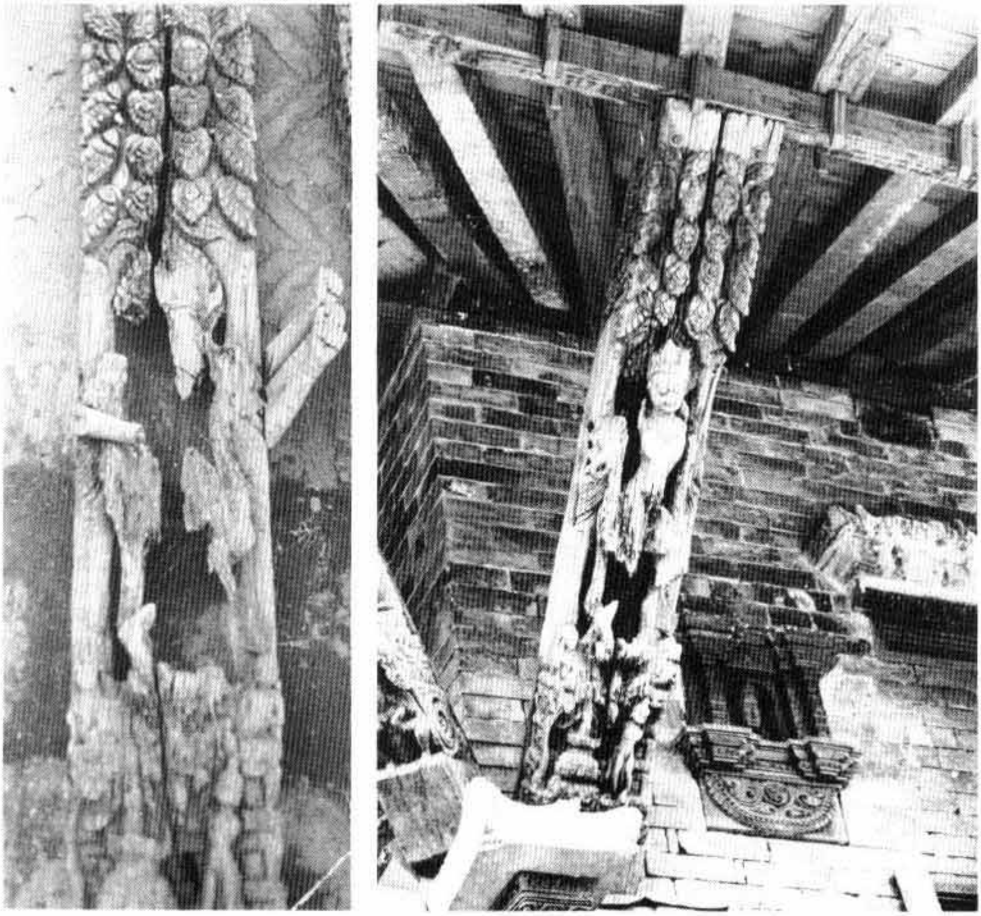
Radha Krsna Temple: 4 generations of struts at middle roof level
Clockwise from upper left middle roof struts of 1967, 1992, 1668, and the 19th century.



Different emanations of the temple's principal deity Vishnu are found in the extended lintels of the sanctuary's doors. From top to bottom: west, south, and north elevations. Notice that adjacent carvings left of the figure also vary by side.

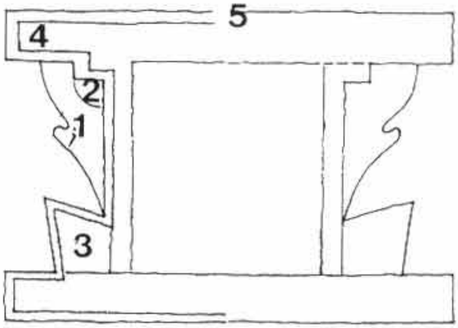


Varying carved floral motifs just below the capitals of arcade-level pillars, two pillars on north elevation. The vertical cracks are typical of historical timbers in Nepal which are never seasoned before carving and installation.



Radha-Krsna Temple: Reconstituted middle roof strut
Left: the 19th century strut as found after 3 years of storage. With the discovery of the lost figure, the elements were reconstituted on a largely concealed anti-corrosive steel frame. Right: the intalled element, May, 1993.

1. gvāgahkva	–	wall bracket with kāynyā (makara) and Gaṅgā/Yamunā or phaikulā (mythic animal) design
2. debikva	–	medallion of wall bracket with Candra/Sūrya, Aṣṭamātṛkā or flower design
3. bhailahkva bhailahkuti	–	panel above the sill with Bhairava design
4. lapu	–	projecting end of sill or lintel
licva	–	projecting end of lintel
lācva	–	projecting end of sill
5. puratva	–	decorative beading around the whole frame



Above: identification of elements from N. Gutschow, Newar Towns and Buildings, 1987. Below left: the east elevation of Radha-Krsna showing lost *Astamatrika* panel and adjacent niche, January, 1992. Right: only on the right side of the south elevation were all iconographic features intact.

Although the authors maintain that either of these approaches could be successfully developed, certain existing conditions and design characteristics of the temple itself as well as local conservation trends helped the project team to decide *not* to fabricate any new figurative carvings in these locations. The fortunate presence of rich but repetitive frames around many of the carved deities, frames whose reproduction without a central image allowed a large part of the historical effect of the facade to be regained, solved the problem for *torana* and niche locations. At the lost carving locations around the doors, however, such repetitive frames were not present.

Here minor deformations of the ground floor masonry structure, which contorted the plain surrounding structural frames of the lost panels, invited replacement with plain timbers. A carved figure on a timber of the historical size would not fit well, while plain timber replacements could, in effect, reduce the negative effect of the spread timber frames, whose repair would necessitate complete rebuilding of the ground floor.[19] Lastly, as the majority of local restoration projects has favored the insertion of new carvings of poor quality in such locations – plain timbers only being interpreted as a sign of a project's running out of money – the project team identified this as an opportunity to refine plain timber replacements for *demonstration* value. Thus, several variations were designed and tested to develop a plain, but elegant solution. The resulting design consists of not one but several vertical boards with a visible joint and several incised border lines. The panel is installed slightly behind what would have been the deepest surface of the lost historical carving and the new wood has been finished to match exactly the color of the adjacent and cleaned historical elements. At a minimum, this solution illustrates the importance of design and finish quality for any replacement piece on an historical building. At best, and in combination with the new figurative roof strut, it will encourage ongoing dialogue about the meeting of international standards of authenticity on the one hand, and the practices of a third world and *living* culture on the other.

19. These wall deformations presented visual not structural problems. It had been decided that rebuilding would sacrifice too much intact historical masonry.

BIBLIOGRAPHY

Nepalese architecture and art

Anderson, Mary M. *The Festivals of Nepal*. London: George Allen and Unwin, 1971.

Bannerjee, N. R. *Nepalese Architecture*. Dehli: Agam Lala Prakashan, 1980.

Gutschow, Niels. «Gorkha: the Architectural Documentation of Two Palaces from the 18th and 19th Centuries». Journal of the Nepal Research Center (vol. vii, 1985). Wiesbaden: 1985.

Gail, Adalbert. *Tempel in Nepal*. Graz: Akademische Druck- u. Verlagsanstalt, 1984.

Gutschow, Niels, Bernhard Koelver, and Ishwaranand Shresthacarya. *Newar Towns and Buildings*. Germany: VGH Wissenschaftsverlag Sankt Augustin, 1987.

Gutschow, Niels. *Stadtraum und Ritual der Newarischen Staedten im Kathmandu-Tal*. Stuttgart: Verlag W. Kohlhammer, 1982.

Kathmandu Valley: *The Preservation of Physical Environment and Cultural Heritage, a Protective Inventory*. 2 vols. Vienna: Anton Schroll.

Koelver, Bernhard. *Re-Building a Stupa*. Bonn: VGH Wissenschaftsverlag, 1992.

Korn, Wolfgang. *Traditional Architecture of the Kathmandu Valley*. Kathmandu: Ratna Pustak Bhandar, 1979.

Kramrisch, Stella. *The Hindu Temple*. Dehli: Motila Banarsidass (rpt. of 1946 ed.), 1976.

LeBon, Gustave. *Voyage au Nepal*. Bangkok: White Orchip Press, 2nd reprint 1986, 1883–86 Paris edition.

Macdonald, A. W. and Anne Vergati Stahl. *Newar Art*. New Dehli: Vikas Publishing, 1979.

Manandhar, Inan Kaji. «Our Traditional Method of Building Construction» in Rolamba v.III no. 3, Kathmandu, 1983.

Pal, Pratapaditya. *Art of Nepal*. Berkeley: University of California Press, 1985.

Pal, Pratapaditya. «The Divine Couple in Himalayan Art», Arts of Asia v.22 #1, Jan–Feb 1992.

Pal, Pratapaditya. *Vaisnava Iconology in Nepal: A Study in Art and Religion. Calcutta: Asiatic Society*, 1970.

Pieper, Jan. «Three Cities of Nepal,» in *Shelter, Sign, and Symbol*, edited by Paul Oliver, pp. 52–69. London: Barrie and Jenkins.

Parajuli, Yogeshwar K. *Bhaktapur Development Project: Experiences in Restoration and Preservation in a Medieval Town (1974–1985)*. Frankfurt: Deutsche Gesellschaft fuer Technisches Zuzammenarbeit, 1986.

Rau, Heimo. «Workshops of Traditional Newar Woodcarving: A Stylistic Analysis». Journal of the Nepal Research Center, (vol vii. 1985) Wiesbaden: Franz Steiner Verlag, 1985.

Slusser, Mary S. «Indresvara Mahadeva, a Thirteenth Century Nepalese Shrine». Rpt. from Artibus Asiae, vol XLI, 2/3.

Slusser, Mary Shepard. *Nepal Mandala*. Princeton: Princeton University Press, 1982.

Wiesner, Ulrich. *Nepalese Temple Architecture*. Leiden: E.J. Brill, 1978.

Wright, Daniel. *History of Nepal*. New Dehli: Asian Publication Services, (rpt of 1877 ed.), 1990.

Zimmer. Heinrich. *The Art of Indian Asia*. Princeton: Princeton University Press, (pprbk ed.; 1946 1st ed), 1983.

Conservation/Technical

Buildings at Risk: Seismic Design for Practicing Architects. Washington: American Institute of Architects/Association of Collegiate Schools of Architecture, 1992.

Feilden, Bernard. *Conservation of Historic Buildings*, London: Butterworths, 1982, rpt 1989.

Fitch, James Marston. *Historic Preservation: Curatorial Management of the Built Environment*. Charlottesville: University of Virginia, 1990.

«International Symposium on the Conservation and Restoration of Cultural Property: the Conservation of Wooden Cultural Property» Tokyo: Organizing Committee of the International Symposium on the Conservation and Restoration of Cultural Property, November 6, 1981.

Langenbach, Randolph. «Bricks, Mortar, and Earthquakes: Historic Preservation vs. Earthquake Safety» in *APT Bulletin*, vol XXI, no. 3/4, 1989.

Mack, Robert C. «Repointing Mortar Joints in Historic Brick Buildings», in Preservation *Briefs* published by the Interagency Historic Architectural Services Program, National Park Service.

Parajuli, Jogeshwar. *Experiences in Preservation and Restoration in a Medieval Town (1974–1985)*. Kathmandu: Sahayogi Press, 1986.

Pearson, R.S. and Brown, H.P. *Commercial Timbers of India*, vol 1. Calcutta: Government of India, 1932.

Sanday, John. *Building Conservation in Nepal*. Paris: UNDP-UNESCO, 1978. (UNDP/NEP/71/006UNDP/NEP/741003 Technical Report).

Sanday, John. «The Hanuman Dhoka Royal Palace Kathmandu – Building Conservation and Local Traditional Crafts». London: AARP (Art and Archaeology Research Papers).

Sekler, Eduard et al. *Masterplan for the Conservation of the Cultural Heritage of the Kathmandu Valley*. Paris: UNDP/UNESCO, 1977.